

Department of Labor and Industry (DLI)
Division of Voluntary Apprenticeship

Student Manual

Youth Apprenticeship Safety Training Program

This material is available to you in different forms -- large print, Braille or audiotape -- if you call (651) 284-5090 (general information) or TTY (651) 297-4198 and request the service.

Manual Overview

You are important to us! We don't want you to get hurt. That's why we have created this basic safety information. We want you to understand how to stay safe before you are given a job. This helps prevent you from getting hurt when you do your job.

There are eight Lessons in this Workbook. You can be asked to do the assignments on your own, or you can be guided through the lessons with an Instructor. Either way, you win. Its better to know the kinds of dangers and the proper way to keep safe before you do something that might get you hurt.

In **Lesson 1** you learn about safety on walking and working surfaces. Then, in **Lesson 2**, you are introduced to the basics of fire protection and emergency exits. Since you can be assigned a job that requires you to use equipment, **Lesson 3** focuses on the protective guards that are on machinery. You can be exposed to electrical hazards too, so **Lesson 4** steps you through these items.

In **lesson 5** you see the basics of hazards and communications terms that you should become familiar with. Your boss can require you to wear certain clothing, gloves, shoes or helmets, so **Lesson 6** helps you understand these kinds of equipment and their use. For your continued safety, **Lesson 7** steps you through the purpose and procedures of tagging and locking certain equipment. And finally, in **Lesson 8** you see how to handle materials safely.

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Instructions

As you step through each of the lessons, you will be asked some beginning questions, called a Pre-Quiz. They are included to help you understand the kind of information that is included in the lesson, and to find out how much you already know about the topic.

At the end of each lesson there is a lesson test. You must complete the test and turn it in to your teacher or supervisor.

Your instructor may distribute a disk for you to take the test. The screen looks like this:

Apprenticeship Safety Training Program - [Table Of Contents]

File Lessons Progress

Your Name
Dave

Lesson	Description	% Answered
<input checked="" type="radio"/> Lesson #1	Walking And Working Surfaces	0%
<input type="radio"/> Lesson #2	Means Of Egress/Fire Protection	0%
<input type="radio"/> Lesson #3	Machine Guarding	0%
<input type="radio"/> Lesson #4	Electrical	0%
<input type="radio"/> Lesson #5	Hazard Communication	0%
<input type="radio"/> Lesson #6	Personal Protective Equipment	0%
<input type="radio"/> Lesson #7	Lockout/Tagout	0%
<input type="radio"/> Lesson #8	Materials Handling	0%
Take Lesson Test		0%

Instructions
As you take each Lesson Test, you are allowed to skip questions and go back to them later. Once you have answered all questions, you can Submit your test result.

Save Test Results
Print Test Results
<-- Total % Answered

APPRENTICESHIP SAFETY TRAINING PROGRAM
Department Of Labor And Industry (DLI)
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By using this program, you can review each lesson by highlighting the Lessons Main Menu item and selecting the topic for review. After reviewing the lesson, you simply choose the lesson Option button and click the "Take Lesson Test" button. You are allowed to skip questions, or go back and change an answer. You can keep track of each test during your studies.

To register, please enter your full first and last name, and your password. After you have completed all tests, the "Total % Answered" box will display 100%. At that time, push the "Save Test Results" or "Print Test Results" button. This will save your test answers to a file. Give the printed results to your instructor. They will grade your test and share your score with you.



1. Walking and Working Surfaces

Introduction

Did you know that slipping, tripping and falling cause most of the injuries at work? More than 15% of these accidents actually cause death. We want you to know the reasons that cause these injuries so you can protect yourself. We don't want you to end up in a hospital or even a cemetery.

This lesson introduces you to the basics of walking and working surfaces. This includes:

- Housekeeping
- Aisles and passageways
- Covers and guardrails
- Floor loading limits

In addition, you find out how to protect yourself and others from **openings** and **holes** in **floors** and **walls**. Of course this includes **platforms** and **runways**. Since **stairs** also cause accidents, we include a section for these as well. Your job can require that you climb. That's why we have also included a special section for **ladders** and **scaffolding**.

Purpose

In **Lesson 1** you learn about safety on both walking and working surfaces.

Objectives

You learn how to avoid or prevent slipping, tripping and falling as you do your job.

Outcomes

After you complete Lesson 1 you can name potential safety hazards. You can bring these problems to your supervisor. You can correct many of the problems yourself to prevent slipping, tripping and falling accidents.

Quiz

1. When you are in a hurry to get supplies to another floor, you should:
 - A) Take two steps at a time.
 - B) Run up the stairs.
 - C) Throw the supplies up the stairs.
 - D) Carry the supplies while holding the handrail.

2. If you are told to clean a room, you should:
 - A) Find a hole to put the dirt into.
 - B) Make sure that the room doesn't have safety hazards.
 - C) Secure the area.
 - D) Take a break.

3. When you are told to do work on top of a platform, you should:
 - A) Look for guard rails to protect you from falling.
 - B) Say "No", because you are afraid of height.
 - C) Bring a friend up there too.
 - D) Wear protective mountain-climbing equipment.

General Safety

Housekeeping

The most usual reasons for injuries involve housekeeping.

- All places where you work including hallways, storerooms, and service rooms are kept clean, orderly and sanitary.
- The floor of every room is clean and dry. When liquids are used, there is drainage with gratings, mats, or raised platforms.
- Every floor, working place and passageway shouldn't have any protruding nails, splinters, holes, or loose boards.

Aisles and Passageways

- Aisles, hallways and passageways are kept clear and in good repair with no obstacles that could get you hurt.
- Permanent aisles and passageways are marked.

- Where mechanical handling equipment is used, aisles are wide enough. If they aren't, or there is poor housekeeping, any vehicle traffic could cause injury to you, damage the equipment, the material, or can hinder your exit in emergencies.

Covers and Guardrails

Covers and guardrails are provided to protect you from the hazards of open pits, tanks, vats and ditches.

Floor Loading Protection

Load rating limits or the most amount of weight allowed, is marked and posted with signs where you can see them. It is against the law to put anything on a floor or roof that is heavier than what the weight limit is.

Floor and Wall Openings and Holes

Floor and wall openings, holes, and the open sides of platforms might cause a safety hazard. You can fall through the openings or over the sides to the level below. Objects, such as tools or parts, can fall through the holes and hit you or damage machinery on lower levels.

There are some definitions for openings and holes in floors or walls:

Floor hole. An opening that is between 1 inch and 12 inches in a floor, platform, pavement or yard that material can fall through, but you can't.

Floor opening. An opening that is more than 12 inches in any floor, platform, pavement or yard, that you can fall through.

Platform. A working space raised higher than the floor or ground.

Wall hole. An opening between 1 inch and 30 inches high in any wall or partition.

Wall opening. An opening at least 30 inches high and 18 inches wide in any wall or partition that you can fall through.

Protection for Floor Openings

When there is an opening in the floor, like a stairway, standard railings are put on all open sides, except at the entrance. For stairs that are not used too much, or you can walk across the opening without a railing, there is a hinged door (or trap door) to cover the stairs along with removable standard railings on all open sides, except at the stairway entrance.

A "standard railing" has a top rail, mid rail, and posts. The top rail is 42 inches from the top of the rail to the floor or platform. The middle rail is 21 inches from the floor.

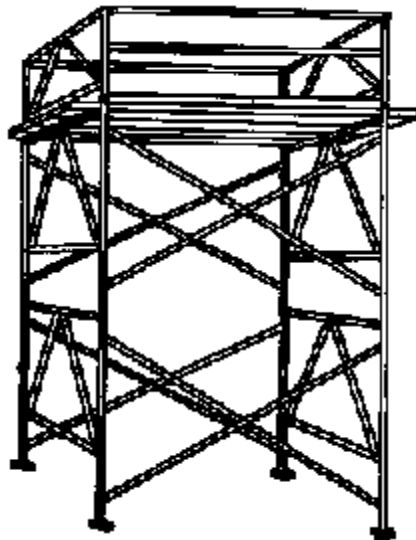
Every floor hole that you can accidentally walk into is guarded by:

- A standard railing with a toeboard, or
- A floor hole cover.

A "standard toeboard" is 4 inches high, with ¼ inch clearance above the floor.

Floor openings can be covered rather than guarded with rails. When the floor opening cover is removed, a temporary guardrail is used, or someone should be at the opening to warn you.

When the cover is not in place, the floor hole should have someone to watch for danger or the opening has a removable standard railing.



Protection of Open-Sided Floors, Platforms and Runways

One of the reasons you can get hurt is that every open-sided floor or platform higher than 4 feet above a floor or the ground isn't always guarded by a railing on all open sides, except where there is an entrance to a ramp, stairway, or fixed ladder. The railing has a toeboard below the open sides when:

- You can pass,
- There is moving machinery, or
- There is equipment with materials that might fall and create a hazard

Every runway is guarded by a standard railing on all sides that are more than 4 feet above the floor or ground. Wherever tools, machine parts or materials might be used on the runway, a toeboard is provided on each exposed side.

Open-sided floors, walkways, platforms, and runways around dangerous equipment, like tanks and degreasing units, are guarded with a standard railing and toeboard.

Stairway Railings and Guards

Stairs with four or more steps have standard railings or handrails. The stairs are not supposed to have anything on them, except the handrails.

On stairs that are less than 44 inches wide:

- If both sides are closed, there is at least one handrail, usually on the right side as you are going down the stairs.

- If there is one open side, there is at least one handrail on the open side.
- If both sides are open, there are two handrails, one for each side.

On stairs that are between 44 and 88 inches wide:

- There is one handrail on each closed side and one handrail on each open side.

On stairs wider than 88 inches:

- One handrail is on each closed side, one handrail on each open side, and one stair rail in the middle of the stairs.

A "standard stair railing" is similar to a standard railing, but it is only between 30 and 34 inches from the top rail to the steps.

A "standard handrail" is located on a wall or partition with brackets on the lower side of the handrail. This is in order to keep a smooth surface on the top and sides of the handrail. The brackets hold the rail 3 inches from the wall and are less than 8 feet apart.

The height of handrails can't be less than 30 inches or more than 34 inches from the top rail to the top of the steps.

Winding stairs have a handrail that is offset to prevent you from walking on any portion of the steps where they are less than 6 inches wide.

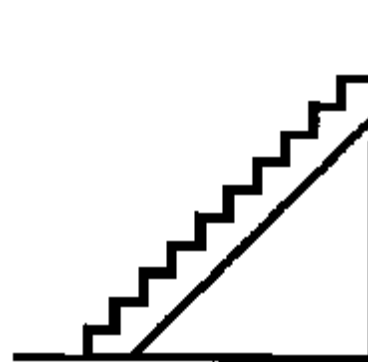
Stairs

Fixed Industrial Stairs

Fixed industrial stairs include interior and exterior stairs around machinery, tanks, and other equipment, and stairs leading to or from floors, platforms or pits. This does not include stairs used for fire exits, to construction operations, to private residences, or to articulated stairs, like those on floating roof tanks.

Fixed industrial stairs are provided for access to and from places where you travel between levels. They are designed to be:

- Strong enough to carry five times their normal load,
- Safe enough to carry 1000 pounds,



- At least 22 inches wide,
- At angles between 30° and 50°, and
- At least 7 feet from the edge of the step to the ceiling so you don't bump your head.

When looking at the condition of stairs at work, here are some things to watch out for.

- For Handrails and Stair rails:
 - A. Not having any handrails and stair rails,
 - B. Where the handrails and stair rails are located,
 - C. The smoothness of handrails and stair rails,
 - D. Strength of handrails and stair rails, and
 - E. Clearance between the handrails and the wall.
- For Treads and Steps:
 - F. Strength
 - G. Slip resistance
 - H. Dimensions
 - I. Evenness of surface
 - J. Visibility of leading edge
- Wet, slippery, or damaged walking or grasping surfaces.
- Improper lighting.
- Poor housekeeping

The length of a staircase is important. Long flights of stairs usually have landings, or small platforms, so that you can rest before continuing. The landings are usually at every tenth or twelfth step. These landings and platforms are the same width as the steps and at least 30 inches long.

Ladders

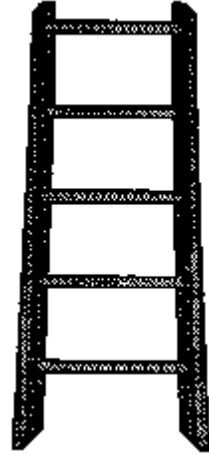
Portable Ladders

The biggest safety hazard when using a ladder is falling. If a ladder is not maintained or used properly, it can collapse and cause you to fall.

A ladder is a tool that has two side rails and steps to help you go up or down.

The various types of portable ladders include:

- **Stepladder** - A self-supporting portable ladder that is not adjustable, has flat steps and a hinged back.
- **Single Ladder** - A portable ladder that is not self-supporting, not adjustable and has only one section.
- **Extension Ladder** - A portable ladder that is not self-supporting, but is adjustable.



Safety rules for portable ladders include:

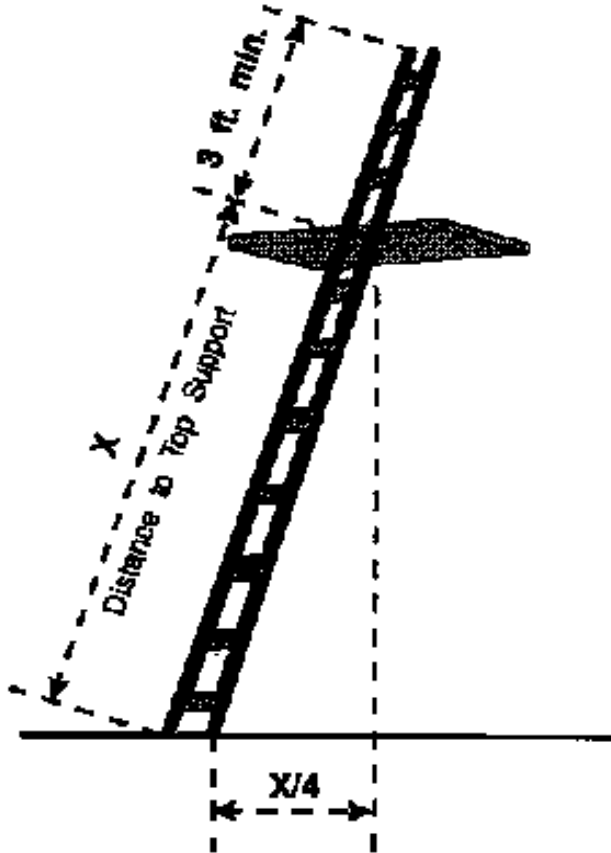
- Portable stepladders longer than 20 feet can't be used.
- Stepladders have a metal locking device to hold the front and back sections in an open position.
- Single ladders longer than 30 feet can't be used.
- Extension ladders longer than 60 feet can't be used.
- Ladders are in good condition at all times.
- Ladders are inspected frequently. Those ladders that have defects have to be repaired, destroyed or marked as "Dangerous, DO NOT USE."

The proper use of ladders can prevent accidents. Even a good ladder can be a serious safety hazard when you use it in a dangerous way.

You should follow these safety tips when using ladders:

- Ladders are put on a solid surface or are held in position.

- Ladders used to gain access to a roof or other area extend at least 3 feet beyond the top support. For example, a twelve-foot ladder should extend 3 feet beyond the top support. That means that this ladder can only reach 9 feet from the floor or ground.



- The bottom or foot of a ladder should not be closer than one-fourth the total length from the top support of the ladder. For example, if the top support for a ladder is ten-foot high, the foot of the ladder should not be closer than 2 and ½ feet.
- You always face the ladder when climbing up or down.
- Short ladders can't be spliced together to make long ladders.
- Ladders can never be used in the horizontal position as scaffolds or work platforms.
- The top of a regular stepladder can't be used as a step.
- Use both hands when climbing or descending ladders.
- Metal ladders are never used near electrical equipment.

Fixed Ladders

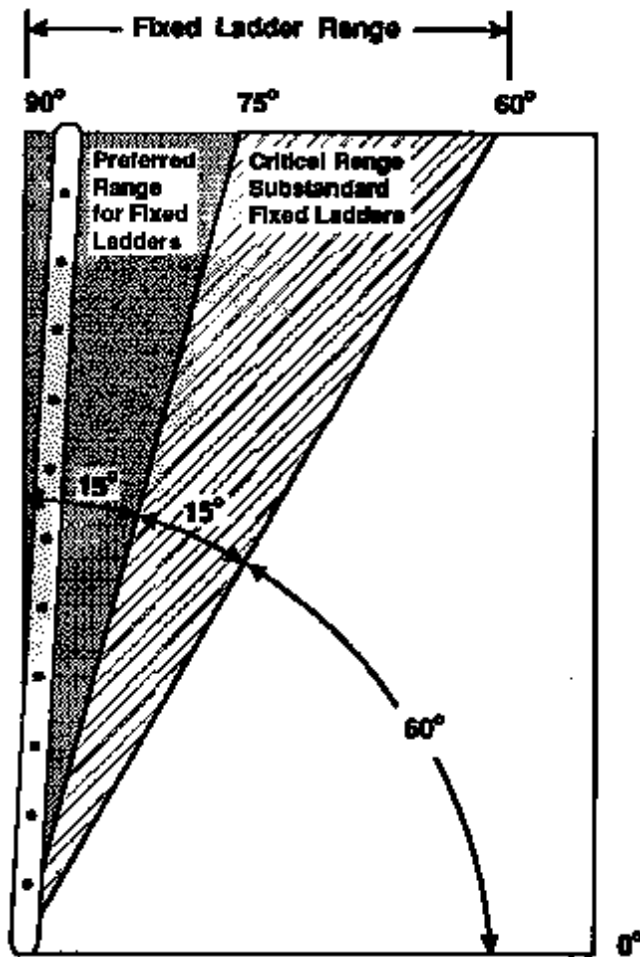
A fixed ladder is a ladder that is permanently attached to a structure, building or equipment.

Fixed ladders that are 20 to 30 feet long have cages or other safety devices.

A "cage" is a guard that is fastened to the side rails of the fixed ladder or to the structure. A cage is used to enclose the ladder so you don't fall as you climb. Cages extend at least 42 inches above the top of a landing, just like stair railings, unless other protection is provided. Cages extend down the ladder to 7 or 8 feet above the base of the ladder.

A ladder safety device, other than a cage, can also reduce accidental falls. These devices can be life belts, friction brakes, and other sliding attachments.

Another feature of fixed ladders is the landing platform. This gives you a way of stopping a fall and serves as a resting-place during long climbs.



When fixed ladders are used to climb higher than 20 feet (except on chimneys), landing platforms are provided every 30 feet when cages are used. When there is no cage or ladder safety devices are used, landing platforms are provided every 20 feet.

Ladder safety devices can be used on tower, water tank, and chimney ladders over 20 feet instead of cage protection. No landing platform is required in these cases.

The angle of fixed ladders is usually 75 to 90 degrees. Fixed ladders are considered substandard if they are between 60 and 75 degrees. They are permitted only when necessary to meet certain installation conditions. Ladders that have an angle greater than 90 degrees are forbidden.

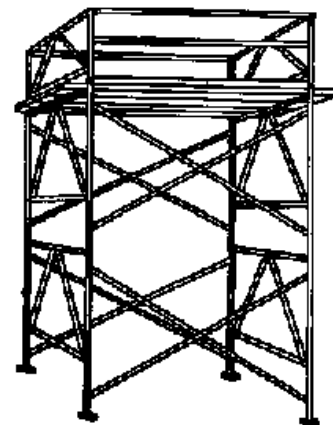
As with all ladders, fixed ladders are maintained in a safe condition and inspected regularly.

Scaffolding

There are special rules for the operation, maintenance and use of different types of scaffolds available in buildings and structures.

It is important to understand the following safety rules about scaffolds:

- The footings or anchors for scaffolds should support at least four times their maximum intended load without settling. Unstable objects, such as barrels, boxes, loose brick, or concrete blocks are not used to support scaffolds or planks.



- Scaffolds are maintained in a safe condition and can't be altered or moved while they are in use or occupied.
- Damaged or weakened scaffolds must be immediately repaired and can't be used until repairs have been completed.
- A safe means is provided to get to the working platform of the scaffold by using a ladder or ramp.
- Overhead protection is provided for you on a scaffold exposed to overhead hazards.
- Guardrails, middle rails, and toeboards are installed on all open sides and ends of platforms more than 10 feet above the ground or floor. Wire mesh is installed between the toeboard and the guardrail along the entire opening, where you are required to work or pass under the scaffolds.
- You can't work on scaffolds during storms or high winds or when covered with ice or snow.

Manually Propelled Mobile Ladder Stands and Scaffolds

There are general safety rules for working with mobile work platforms, ladder stands and rolling or mobile scaffolds and towers. These include:

- All exposed surfaces of mobile ladder stands and scaffolds are free from sharp edges, burrs, or other safety hazards.
- The maximum work height is less than four times the minimum dimension of the base unless outriggers, guys or braces are added to provide stability.
- This standard requires guardrails and toeboards for work levels 10 feet or more above the ground or floor.

Other Working Surfaces

There is another important safety rule that can prevent many serious accidents. Portable dockboard (bridge plates) must be secured in position, either by being anchored or equipped with devices that will prevent their slipping. Movement of the dockboard during material handling operations has resulted in forklifts overturning, or falling off the dock, often with serious injury or death to the driver and damage to equipment and material.

Material handling can also cause serious accidents. Handholds are provided on portable dockboards to allow safe handling when the dockboard has to be repositioned or relocated.

Summary

In lesson 1 you were introduced to the basics of **walking and working surfaces**. This included:

- Housekeeping
- Aisles and passageways
- Covers and guardrails
- Floor loading limits

In addition, you found out how to protect yourself and others from **openings** and **holes** in **floors** and **walls, platforms, runways, and stairs**. Your job can require that you climb. That's why you also learned about **ladders** and **scaffolding**.

A detailed outline of Lesson 1 summarizes each area that you learned as follows:

A. General Safety

1. Housekeeping
2. Aisles and Passageways
3. Covers and Guardrails
4. Floor Loading Protection

B. Floor and Wall Openings and Holes

1. Floor hole, Floor opening, Platform, Wall hole, Wall opening
2. Protection for Floor Openings
3. Protection of Open-Sided Floors, Platforms and Runways
4. Stairway Railings and Guards

C. Stairs, Ladders, Scaffolding

1. Fixed Industrial Stairs
2. Portable Ladders (Stepladder, Single, Extension, Fixed)
3. Manually Propelled Mobile Ladder Stands and Scaffolds

D. Other Working Surfaces

Lesson 1 Test – Walking and Working Surfaces

1. **Slipping, tripping and falling cause most of the injuries at work. What percent of these accidents actually cause death?**
 - a) 10%
 - b) 15%
 - c) 20%
 - d) 25%
2. **Some of the most frequent reasons for injuries involve housekeeping. Which reason is not housekeeping related?**
 - a) All places where you work, including hallways, storerooms, and service rooms aren't kept clean, orderly and sanitary.
 - b) The floor of every room isn't clean and dry. When liquids are used, there isn't drainage with gratings, mats, or raised platforms.
 - c) All hallways, storerooms, and service rooms where you work don't have adequate lighting.
 - d) Every floor, working place and passageway doesn't have protruding nails, splinters, holes, or loose boards.
3. **Floor and wall openings, holes, and the open sides of platforms might cause a safety hazard. Which item below is considered the worst safety hazard?**
 - a) Stairs with less than four steps that do not have standard railings or handrails.
 - b) Stairway railings less than 42 inch high.
 - c) Open-sided platforms less than 4 feet above a floor not guarded by a railing on all open sides.
 - d) A floor hole opening that is 3/4 inch in a floor, platform or pavement.
4. **Fixed industrial stairs are provided for access to and from places where you travel between levels. They are designed to be:**
 - a) At least 20 inch wide.
 - b) Safe enough to carry 2000 pounds.
 - c) Strong enough to carry five times their normal load.
 - d) At least 8 feet from the edge of the step to the ceiling so you don't bump your head.

5. If a ladder is not used properly, it can collapse and cause you to:
- a) Fall.
 - b) Get pinched.
 - c) Trip.
 - d) Break your leg.
6. The proper use of ladders can prevent accidents. Which item below is not a safety tip when using ladders?
- a) Ladders are put on a solid surface or are held in position.
 - b) Ladders used to gain access to a roof or other area extend at least 3 feet beyond the top support.
 - c) Short ladders are spliced together to make scaffolds or work platforms.
 - d) You always face the ladder when climbing up or down
7. A "cage" is a guard that is fastened to the side rails of a fixed ladder or to a structure. Which item below does not clearly state the purpose of a "cage"?
- a) A cage is used to enclose the ladder so you don't fall as you climb.
 - b) Cages protect other employees from falling materials.
 - c) Cages extend at least 42 inches above the top of a landing, just like stair railings.
 - d) Cages extend down the ladder to 7 or 8 feet above the base of the ladder.
8. There are special safety rules for the use of scaffolds available in buildings and structures. Which real safety rule applies to scaffolds?
- a) Scaffolds can be moved while they are in use or occupied.
 - b) A cage is provided on a scaffold exposed to overhead hazards.
 - c) A safe means is provided to get to the working platform of the scaffold by using a ladder or ramp.
 - d) You can work on scaffolds during storms or high winds or when they are covered with ice or snow if you are wearing the proper personal protective equipment.

9. There are general safety rules for working with mobile work platforms, ladder stands and rolling or mobile scaffolds and towers. These do not include:

- a) All exposed surfaces of mobile ladder stands and scaffolds are free from sharp edges, burrs, or other safety hazards.
- b) The maximum work height is less than four times the minimum dimension of the base unless outriggers, guys or braces are added to provide stability.
- c) This standard rule requires guardrails and toeboards for work levels 10 feet or more above the ground or floor.
- d) The footings for scaffolds support four times their intended load. Objects such as barrels, boxes, loose brick, or concrete blocks can be used to support scaffolds or planks.

10. Which of the following statements is not a true statement regarding working surfaces?

- a) Portable dockboard (bridge plates) must be secured in position, either by being anchored or equipped with devices that will prevent their slipping.
- b) Movement of the dockboard during material handling operations has resulted in forklifts overturning, or falling off the dock.
- c) Serious injury or death to the driver and damage to equipment and material results from large holes in the work surface.
- d) Handholds are provided on portable dockboards to allow safe handling when the dockboard has to be repositioned or relocated.

2. Means of Egress/Fire Protection

Introduction



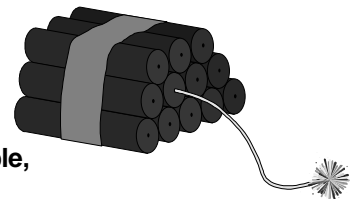
apartment buildings, practically everywhere. Yet you rarely notice them unless you really look for them, even at work.

In this lesson you are introduced to safety in your work relating to **fires** and **exits**. This includes:

- Emergency exit safety
- Exit markings and signs
- Lighting and handicap escapes
- Sprinklers, extinguishers and hoses
- Fire detection and alarms
- Emergency exit plans
- Protective equipment

In addition, you find out how to protect yourself and others from **explosions, earthquakes, smoke, toxic vapors, bomb threats, storms and floods.**

Keep in mind that your concern is for the protection of people, not the building.



The National Fire Protection Association in Massachusetts is used for most local fire codes.

The Life Safety Code was accepted in 1913. It all started with the Committee on Safety to Life, which is part of The National Fire Protection Association. At first, this committee studied fires involving loss of life. That led to standards for stairs and fire escapes, for fire drills and for the arrangement of exits for factories and schools.

In 1912, the committee increased to provide the guidelines for exits and life safety from fire in all buildings. This guide was known as the Building Exits Code.

The Coconut Grove nightclub fire in Boston in 1942, where 492 people died, had national attention on how important exits and fire safety was. The public was even more aware of exits with many hotel fires in 1946. The Building Exits code, after that, was used for creating laws. The code was not in a form to be passed into law and the entire code was changed so that the safety rules could be enforced.

In 1966, the code title was changed from "Building Exits Code" to "The Code for Safety to Life from Fire in Buildings and Structures," known as the "Life Safety Code."

Purpose

This lesson is all about making sure that you have a safe and easy way of leaving a building in an emergency, that a way will be there if you need it and that you will have few problems finding it and using it. You will also find out that there are detection devices and other ways to protect you from fires and other safety hazards.

Objectives

During this lesson you will learn the general safety rules for giving you the "means of egress" (a way to exit) from buildings. You will learn the meanings of terms, general safety rules that are basic to the safe and efficient way to egress (or exit) from buildings, and the requirements to make sure that these subjects are covered.

In addition, there are sections on the safety rules for exit markings and signs.

Outcomes

Throughout this lesson, the emphasis appears to be on escaping from fires. While this is the main reason for emergency egress from a building, it is not the only reason. Additional hazards that you may face include:

- Explosion
- Earthquake
- Smoke (without fire)
- Toxic vapors
- Bomb threat
- Storms (tornado, hurricane, etc.)
- Flash floods

- Nuclear radiation exposure
- Actions or threatened actions of terrorist groups, mentally ill persons, or political radicals
- Other reasons

Each of these hazards can happen by themselves or in combination with others. Depending on the hazard, the individual that might be involved, the kind of building, and the quality of the means of escape provided, each hazard can become more complex by:

- Panic and confusion
- Poor visibility
- Lack of information or misinformation

These things often cause more injuries and deaths than the hazard itself. Providing the proper means of egress can let you escape from the main hazard with success.

The safety rules are general and do not deal specifically with specialized buildings or their use.

Quiz

1. An "egress" is?
 - A) A bird.
 - B) A fire detector.
 - C) A way to exit.
 - D) A fire hazard.
2. An emergency action plan is?
 - A) An escape route.
 - B) A floor plan.
 - C) An attendance sheet.
 - D) An emergency phone list.
3. Automatic sprinklers:
 - A) Give an alarm.
 - B) Spray water.
 - C) Detect fires.
 - D) Dial the fire department.

General Requirements

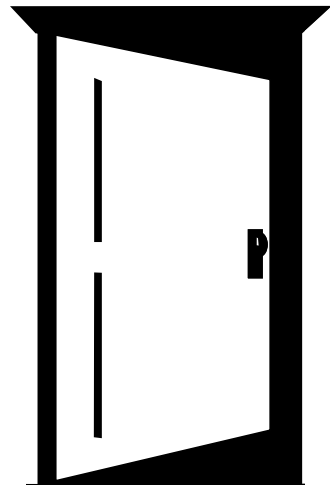
Application

This part of the lesson has the basic safety rules to provide a safe means of egress from fire and emergencies. These rules are not intended for the exit from vehicles, vessels, or other moving structures. The “**means of egress**” actually means “**a way to exit or escape**” from buildings. This lesson uses both phrases so that you are able to remember and understand them better.

Basic Requirements

These safety rules apply to all buildings, new or old, that are intended for people:

- Buildings have exits that allow your quick and easy escape in an emergency.
- Exits and safeguards can't depend on any single safeguard only.
- Building structures are not allowed to cause danger to people during escape.
- Locks are not allowed on doors or exits, since this would prevent emergency egress. The exception is in specialized facilities, such as mental, penal, or corrective institutions where attendants are on duty.
- You must be able to easily see and understand the means of egress if you are physically and mentally capable to know the direction of escape.
- Any doorway or hallway that might be mistaken for an exit, but isn't is clearly marked "Not an Exit."
- Adequate and reliable lights are provided for all exits in every building equipped with electricity.
- When a fire can't give a warning to people, fire alarms are provided to warn you of the fire.
- Emergency egress is not allowed to cause hazard to you under normal conditions.



These basic safety rules are described in more detail later in this lesson.

Construction and Repair

Buildings are normally not occupied during construction or major renovation. When construction is in progress, those that live in the building must be protected.

These activities can't create any danger or limit egress beyond the normal conditions of the building. When these safety rules can not be met, the building can't be occupied.

Maintenance

Every required exit, way of approach, and way of travel from the exit into the street or open space must be free of all obstructions for full instant use in case of fire or other emergency.

Every automatic sprinkler system, fire detection and alarm system, exit lighting and fire door must be in proper operating condition.

Means Of Egress Contents

Egress: As defined by Webster: "A place or means of going out."

Means of Egress: A means of egress is a continuous and unobstructed way of exit travel from any point in a building or structure to a public way and consists of three separate and distinct parts: the way of exit access; the exit; and the way of exit discharge.

A means of egress includes the vertical and horizontal ways of travel and includes midway room spaces, doorways, hallways, corridors, passageways, balconies, ramps, stairs, enclosed areas, lobbies, escalators, horizontal exits, courts, and yards.

Note: The word "way" means a route or path, not a method.

Exit Access: Exit access is a means of egress that leads to an entrance to an exit.

Exit: Exit is a means of egress that is separated from all other spaces of the building or structure by construction or equipment to provide a protected way of travel to the exit discharge.

Exit Discharge: Exit discharge is a means of egress between the termination of an exit and a public way.

High-hazard Contents: High-hazard contents are those that burn rapidly or poisonous fumes or explosions that could occur during a fire.

Emergency Action Plan: Means a plan for a workplace describing what procedures your employer and the employees take to make sure that you are safe from fire or other emergencies.

Emergency Escape Route: The route that employees follow in the event they need to evacuate the workplace or find a designated refuge area.

Parts of an Exit

An exit has only approved parts. Exits are part of the building or are permanently attached. For example, if a door to an exit or to a way of exit access is not side-hinged and swinging type, it is not an approved exit.

Exit applies to all parts of the means of egress. An ordinary outside fire escape found with older buildings is not recognized as a safe means of egress in new building construction.

Fire Resistance of Exits

The measure of fire resistance rating is the time in hours that materials have withstood a fire during tests.

When an exit is protected by separation from other parts of the building, the separation meets the following safety rules:

- Three stories or less has one hour fire resistance,
- Four or more stories have two hour fire resistance,
- Openings are protected by approved self-closing fire doors, and
- Openings in enclosed area exits are limited to access to the enclosed area from normally occupied spaces and for egress from the enclosed area.

What this rule means is that the exit provides protection long enough to be used by the occupants of a building.

Size of Means of Egress

The capacity in numbers of people per exit width is:

- 100 people /unit for Level and Class A Egress Components, and
- 60 people /unit for Inclined and Class B Egress Components.

A Class A ramp has a slope less than 1 3/16 inches per foot, at least 44 inches wide, and no limit on the maximum height between landings. A Class B ramp has a slope of 1 3/16 to 2 inches per foot, is 30 to 44 inches wide, and a maximum height between landings of 12 feet.

Means of egress is measured in units of 22 inches wide exits. Fractions of a unit aren't counted, except that 12 inches added to one or more full units are counted as one-half an exit width.

Units of exit width are measured in the clear at the narrowest point of the means of egress, except that:

- Handrails can't be more than 5 inches;

- Stair stringers can't be more than 1-½ inches.

An exit or exit access door swinging into an aisle or hallway can't restrict the width during its swing.

Capacity and Occupant Load of Means of Egress

When capacity has been determined for each means of egress, the estimated occupant load for the means of egress is calculated.



- Capacity of means of egress is sufficient for occupant load of any space served.
- Occupant load is the maximum number of people that can be in a space at any time.
- Capacity of the exits at a floor can be based on individual floor occupant loads.
- Exit capacity can't decrease in the direction of exit travel.

For additional information concerning egress capacity and occupancy load you can refer to the National Fire Protection Association (NFPA) which has specific requirements for individual occupancies.

Arrangement of Exits

When multiple exits are required for a floor, at least two of the exits are separated from each other as far as possible to minimize chances of more than one being blocked.

Access to Exits

The basic safety rules include:

- Exits are readily accessible at all times.
- Doors from a room to an exit or way of exit access are side-hinged, swinging type and swing with exit travel when the room is occupied by more than 50 people or used for a high hazard occupancy.
- Access to an exit can't be through a bathroom or other room that can be locked, except when the exit is only for that room.
- Access to exits must be clearly recognized.
- Exit doors can't be disguised, covered, concealed, or decorated to confuse their purpose.
- Mirrors can't be put on or near exit doors.

- Routes of exit access can never be toward a high hazard location, unless effectively shielded.
- Minimum width of any way to an exit is 28 inches.

Exterior Routes of Exit Access

Under certain conditions it is permitted to plan an exterior route as a way of exit access from one interior part of a building to another or to an exterior exit. Such routes may include flat roof tops, closed courtyards and balconies.

Specific safety rules for exterior access routes include:

- Smooth, solid, level floors.
- Guard rails on open sides above ground level.
- Covered by roof if snow or ice could accumulate.
- Permanent, reasonably straight route of travel.
- No obstruction to use of exterior access route.
- No dead-ends longer than 20 feet.

Normally, when you think of an "exit" you think of a door that you go through from the inside to the outside. An exit can be a doorway, and it can also be an interior stairwell, or it can be an exterior "fire escape."

An exit is that part of a means of egress that is separated from all other spaces with a door or balcony to provide a protected way of travel to the exit.

Evacuation from Exits

The safety rules for exit discharges are:

- Evacuations directly to the street or to a yard, a court, or other open space leading to the street.
- The evacuation area, including the street, is large enough for all that leave the building from the exit.
- Stairs and other exits are clear for the direction of egress to the street. Exit stairs that continue beyond the floor of discharge are interrupted at the floor of discharge by partitions, doors, or other effective means.

Headroom

Means of egress has a minimum ceiling height of 7 feet, 6 inches and any projection from the ceiling (lights, etc.) are at least 6 feet, 8 inches from the floor.

Changes in Elevation

Where a means of egress is not level, the differences in elevation have stairs or ramps.

Maintenance and Obstacles

One of the most frequent safety violations is that the means of egress isn't always free of obstacles for immediate use in the case of fire or other emergencies.

Any exit alarms or devices installed to restrict the improper use of an exit must not, even in cases of failure, prevent the emergency use of such exit.

Doors, stairs, ramps, hallways, signs, and all other parts of the means of egress must be reliable.

Decorations

No furnishings or decorations are permitted that obstruct the means of egress. This is likely to happen during holiday seasons.

No furnishings or decorations of an explosive or highly flammable character are permitted.

Fire Protection

This lesson has focused on making sure that you can exit from a building under emergency conditions. It also contains ways to prevent or reduce risk of an emergency. Automatic sprinklers and fire retardant paints are inspected, tested, maintained, and replenished or renewed to keep them in good operating condition.

Exit Signs

There are two categories for exit signs:

- Signs or markings that clearly identify an exit, or the way to an exit.
- Signs or markings that clearly identify doors or areas which are not means of egress.



The safety rules are:

1. Every exit is marked by a clearly visible sign with the word EXIT in plainly legible letters at least 6 inches high and at least $\frac{3}{4}$ " wide.
2. When the way to an exit is not readily clear, signs or markings similar to exit signs are provided to provide directional information. Where arrows are used, they are obvious for giving the direction of the exit.
3. Doors, passageways, and stairs that are not means of egress are marked "NOT AN EXIT" or another sign to show what they really mean so that they can't be confused with the access to exits.

4. Exit signs have a "reliable" light source on the surface.
5. Exit signs and exit access signs are located so that they are visible. Other building furnishings, decorations or equipment, are not allowed to confuse you from finding the exit sign.

Emergency and Fire Prevention Plans

Your employer should have emergency and fire prevention plans at your workplace.

Emergency Action Plan

Elements

The emergency action plan is in writing, except for employers with less than 10 employees. In that case the plan can be explained to you. The plan includes the following elements:

1. Escape procedures and escape route assignments;
2. Critical operations shutdown procedure;
3. Procedure to keep track of all employees;
4. Rescue and medical duties assignment;
5. Means of reporting fires and emergencies; and
6. Identification of responsible people for more information.

The emergency action plan should include all potential emergencies that can be expected in the workplace. It can be helpful to perform a hazard audit to find potentially toxic materials and unsafe conditions. For information on chemicals, the manufacturer or supplier can be contacted to obtain **Material Safety Data Sheets**. These forms describe the hazards that a chemical can present, list precautions to take when handling, storing, or using the substance, and outline emergency and first-aid procedures.

Your employer should list detailed procedures to be taken by employees who have to stay behind to care for essential plant operation until their evacuation is necessary. This can include monitoring plant power supplies, water supplies, and other essential services that can not be shut down for every emergency alarm.

For emergency evacuation, the use of floor plans or workplace maps that clearly show the emergency escape routes and safe or refuge areas should be included in the plan. You must be told what actions to take in emergencies that can occur at work.

Alarm System

Employers must create an employee alarm system. Alarms should be audible or seen by all people in the plant and should have an extra power supply in the event that the electricity goes out. The alarm should be recognized as a signal to evacuate the work area or perform actions designated under the emergency action plan.

Evacuation

Your employer emergency action plan must have the types of evacuation to be used in emergency circumstances. At the time of an emergency, you should know what type of evacuation is necessary and what your role is in carrying out the plan. In some cases where the emergency is life threatening, total and immediate evacuation of all employees is necessary. In other emergencies, a partial evacuation of some employees with a delayed evacuation of others can be necessary for continued plant operation. In some cases, only employees in the immediate area of the fire can be expected to evacuate or move to a safe area. You must be sure that you know what is expected of you in all emergencies that have been planned in order to make sure that you are safe from fire or another emergency.

Safe areas for evacuation should be identified in the plan. In a building divided into fire zones by firewalls, the safe area can still be in the same building but in a different zone from where the emergency occurs.

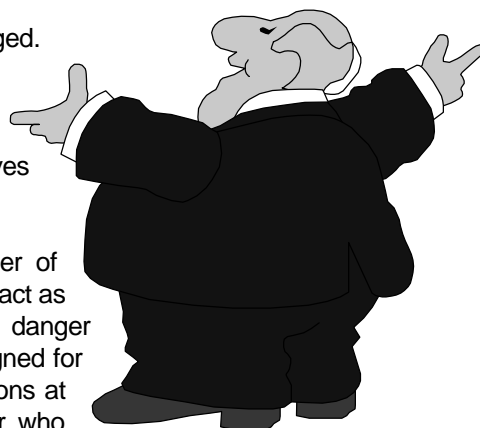
Exterior safe areas can include parking lots, open fields or streets that are located away from the site of the emergency and provide space for the employees. You should be instructed to move away from the exit doors of the building, and to avoid loitering close to the building where you can hamper emergency operations.

Training

Training is important to the effectiveness of an emergency plan.

1. Before using an emergency action plan, you should be trained to help in the safe evacuation of employees. Training for each type of disaster is necessary so that you know what actions are required.
2. Your employer must review the plan with each employee covered by the plan:
 - When the plan is developed,
 - Whenever the employee's responsibilities or designate actions under the plan change, and
 - Whenever the plan is changed.
3. Your employer must review assignments with employees that must know how to protect themselves in case of an emergency.

Your employer should make sure that the right number of employees are available at all times during work hours to act as an evacuation team so that you can be moved from a danger location to the safe areas. Generally, one person is assigned for each 20 employees in the workplace to provide instructions at the time of an emergency. The employees selected or who volunteer should be trained in the complete workplace. All employees should be made aware of handicapped employees who may need extra assistance, using the "buddy



system” and of hazardous areas to be avoided during emergencies. Before leaving, assigned employees should check rooms and other closed spaces in the workplace for others who can be trapped or unable to evacuate the area.

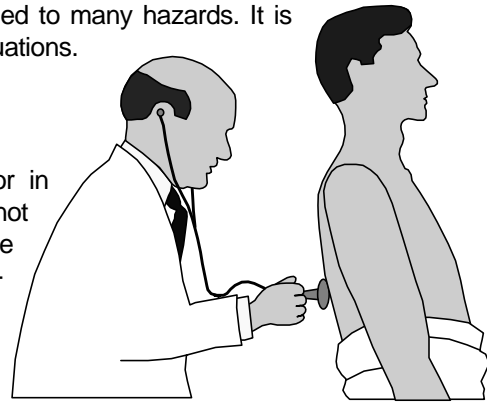
After the evacuation is completed, assigned employees should be able to verify that everyone is in the safe area.

Personal Protection

Personal protection is important for anyone who can be exposed to potentially hazardous substances. In emergencies, you can be exposed to many hazards. It is very important that you are protected in these situations.

Medical Assistance

In a major emergency, time is a critical factor in reducing injuries. Most small businesses do not have a formal medical program, but they are required to have the following medical and first-aid services:



1. In the absence of an infirmary, clinic, or hospital close to the workplace that can be used for the treatment of all injured employees, your employer must make sure that you are trained to give first aid.
2. Where your eyes or body can be exposed to corrosive materials, eyewashes or other equipment for quick drenching and flushing must be provided in the work area for immediate emergency use. You must be trained to use this equipment.
3. Your employer must make sure that medical personnel are available for advice and consultation on matters of employee health. This does not mean that health care must be provided. If health problems develop in the workplace, medical help will be available to solve them.

Fire Prevention Plan

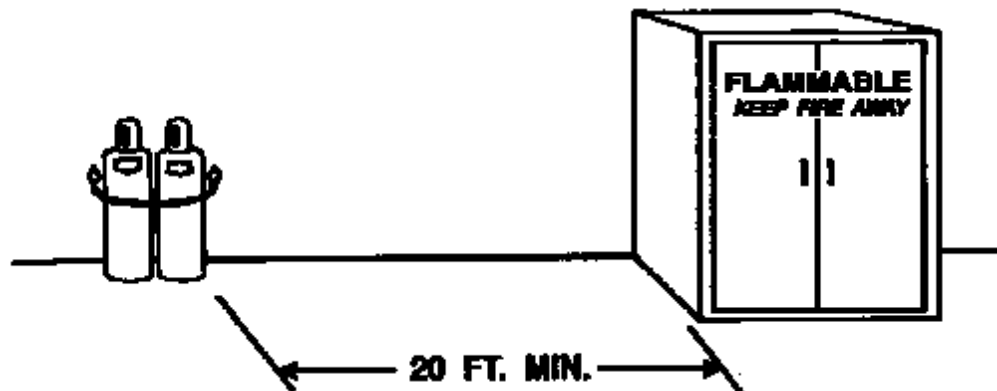
Elements

The following elements are included in a fire prevention plan.

1. A list of all major work place hazards and their proper handling and storage procedures, potential ignition sources and the type of fire equipment or systems to control a fire involving them.
2. Names or job titles of employees responsible for maintenance of equipment and ignition prevention or control systems.
3. Job titles or your responsibility for control of fuel source hazards.

Housekeeping

You should help control the gathering of flammable and combustible waste materials so that they don't contribute to a fire emergency.



Training

Your employer must let you know of the fire hazards, the materials and processes that you are exposed to.

If you are given an assignment, your employer must review those parts of the fire prevention plan that you must know to protect yourself in case of an emergency. The written plan is kept in the workplace and is available to you. The plan doesn't have to be written if there are 10 or less employees. In that case, the plan can be discussed with everyone.

Maintenance

Equipment and systems installed on heat producing equipment are maintained to prevent accidental ignition of combustible materials. These procedures are included in the written fire prevention plan.













Portable Fire Suppression Equipment

This section describes the safety rules for fire brigades and all portable and fixed fire suppression equipment, fire detection systems, and fire and employee alarm systems installed to meet fire protection requirements.

It applies to employment other than maritime, construction and agriculture.

The discussion is limited to fire brigades and portable fire suspension equipment.

There are many important meanings. Some of these are summarized below.

Fire				Class A	Classifications and Extinguisher Types
				Class A/B	
				Class B/C	
				Class A/B/C	

Class D fire. A fire involving combustible metals such as magnesium, titanium, zirconium, sodium, lithium, and potassium.

Dry chemical. An extinguishing agent composed of very small particles of chemicals.

Dry powder. A compound used to extinguish or control Class D fires.

Extinguisher Rating. The numerical rating on an extinguisher that tells the extinguishing capabilities based on standard tests developed by Underwriters' Laboratories, Inc.

Fire brigade. An organized group of employees, that are trained and skilled in at least basic fire-fighting operations.

Halon 1211. A colorless, faintly sweet smelling, electrically nonconductive liquefied gas that is used for extinguishing fires by stopping the chemical chain reaction of fuel and oxygen.

Halon 1301. A colorless, odorless, electrically nonconductive gas that is used for extinguishing fires by stopping the chemical chain reaction of fuel and oxygen.

Beginning stage fire. A fire that is in the beginning stage and can be controlled or extinguished by portable fire extinguishers, Class II standpipe or small hose systems without the need for protective clothing or breathing equipment.

Interior structural fire fighting. The physical activity of fire suppression, rescue, or both, inside of buildings or closed structures that are involved in a fire situation past the beginning stage.

Multipurpose dry chemical. A dry chemical which is approved for use on Class A, Class B and Class C fires.

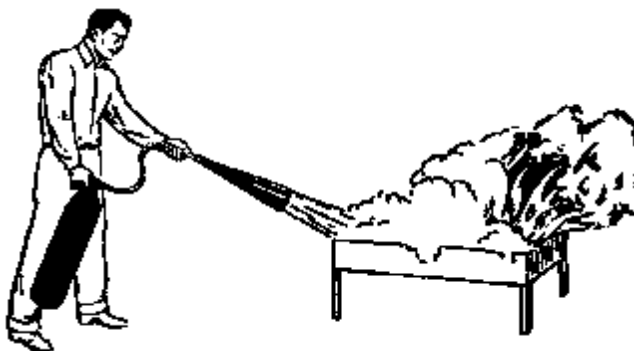
Standpipe systems.

- Class I system means a 2-1/2" hose connection for use by fire departments and other people trained in handling heavy fire streams.
- Class II system means a 1-1/2" hose system that provides a means for the control or extinguishing of beginning stage fires.
- Class III system means a combined system of hose that is for the use of employees trained in hose operations and is capable of providing proper water pressure during advanced stages of fire inside the workplace. Hose outlets are available for both 1-1/2" and 2-1/2" hose.
- Small hose system means a system of hose (5/8" to 1-1/2" diameter) that is for the use of employees for the control or extinguishing of beginning stage fires.

Fire Brigades

This section discusses the safety requirements for the training and personal protective equipment for fire brigades. Your employer is not required to establish fire brigades. If they are established, the requirements of this section must be followed.

This applies to fire brigades, industrial fire departments and private or contractual fire departments. This section does not apply to airport crash rescue or forest fire fighting operations.



Organization

Your employer must prepare and maintain a written policy statement that:

- Establishes the fire brigade and its organizational structure;
- Defines the functions to be performed; and
- States training program requirements.

Your employer makes sure that employees who are expected to do interior structural fire fighting are physically capable of performing the duties that may be assigned to them during emergencies.

Training and Education

Training is provided prior to assignment and is given at least once a year for all fire brigade members. Quarterly training or education sessions are required for fire brigade members that are expected to perform interior structural fire fighting.

Some sources of qualified training instructors are:

- Local Fire Department
- State Fire Marshal's Office
- State University Extension Service
- International Society of Fire Service Instructors
- Community College Fire Science Programs

Fire Fighting Equipment

Your employer maintains and inspects fire fighting equipment at least once a year to make sure that the equipment is safe and in good operating condition. Portable fire extinguishers and respirators are inspected at least monthly.

Protective Clothing

Employees that do fire fighting on the building structure must wear protective clothing. This clothing isn't required for using fire extinguishers or standpipe systems to control or extinguish fires that are in the beginning stage.

Requirements for protective clothing include the following components:

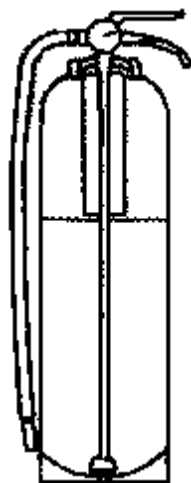
- Foot and leg protection
- Body protection
- Hand Protection
- Head, eye and face protection

Respiratory Protection Devices

Your employer makes sure that fire brigade members can wear respiratory protection devices.

Portable Fire Extinguishers

This section applies to the placement, use, maintenance, and testing of portable fire extinguishers provided for your use.



This does not apply to extinguishers provided for employee's use on the outside of buildings or structures.

Where extinguishers are provided but are not intended for your use and your employer has an emergency action plan and a fire prevention plan, then only inspection, maintenance and testing apply.

You are not required to use extinguishers. When your employer has a total evacuation policy, an emergency action plan, a fire prevention plan and extinguishers are not available in the workplace; your employer does not have to follow all requirements unless a specific standard requires that a portable extinguisher be provided.

When your employer has an emergency action plan that has fire brigades and requires all other employees to evacuate, your employer does not have to distribute the requirements to all employees.

General Requirements

General safety rules regarding portable fire extinguishers include:

- Extinguishers are located and identified so that you can get to them.
- Only approved extinguishers are used.
- Carbon tetrachloride or chlorobromomethane extinguishing agents are not permitted.
- Extinguishers are maintained in a fully charged and operable condition and kept in their designated places at all times except during use.

Selection and Location

Extinguishers are provided for employee use. They have been selected and located based on the classes of potential workplace fires and on the hazard that could affect their use.

Extinguishers are located so that you have access to them from a close travel distance:

Class A . . . 75 feet

Class B . . . 50 feet

Class C . . . Based on the Class A or B hazard.

Class D . . . 75 feet



Training and Education

- If required, you are trained in the use of extinguishers and which hazards they are used on when you are first hired.
- Employees that have been assigned to use fire-fighting equipment must be trained.

Standpipe and Hose Systems

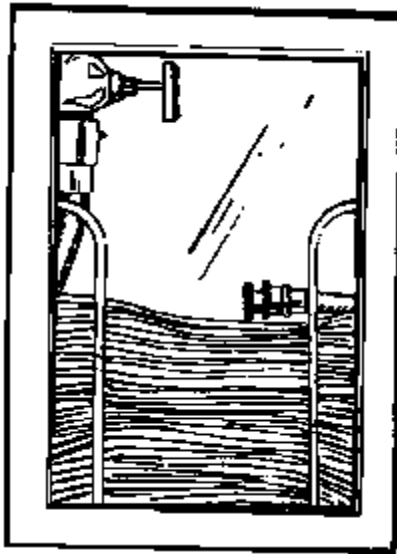
This section applies to all small hose, Class II and Class III standpipe systems. It does not apply to Class I standpipe systems.

Standpipe Equipment and Protection

Standpipes are located or protected against mechanical damage. Damaged standpipes should be repaired promptly.

Hose Reels and Cabinets

Reels or cabinets are used to hold a fire hose. Your employer makes sure that they are in working condition for use at the time of an emergency.



Hose Outlets and Connections

Hose outlets and connections are located high enough above the floor to avoid being obstructed and to be accessible to you.

Hose

Each hose outlet has a hose connected and ready for use.

Where a hose can be damaged by extreme cold, it may be kept in a protected location as long as it is readily available to be connected for use.

Nozzles

Your employer makes sure that a standpipe hose is equipped with shut-off nozzles. There are two basic nozzle types:

- Straight stream
- Fog (variable stream, spray or combination)

Fog is generally preferred.

Water Supply

The water supply for standpipe and hose systems that are provided for the use of employees can provide 100 gallons per minute for at least thirty minutes.

Maintenance

The following maintenance is required for standpipe and hose systems:

- Water supply tanks are to be kept filled except during repairs.
- Valves in the main piping connections to the automatic sources of water supply must always be kept fully open except during repairs.
- Hose systems must be inspected at least annually and after each use.
- Any unserviceable portion of the system must be removed immediately and replaced with equivalent protection during repair.
- Hemp or linen hoses must be unracked, inspected for deterioration, and re-racked using different fold pattern at least annually. Defective hose must be replaced.
- You may be asked to conduct all of these required inspections after you have been properly trained.

Automatic Sprinkler Systems

Automatic sprinklers provide discharge patterns, densities, and water flow for complete coverage. A main drain flow test is performed on each system annually. The inspector's test valve is opened at least every two years to make sure proper operation of the system.

Water Supplies

Every automatic sprinkler system has at least one automatic water supply capable of providing water flow for at least 30 minutes.

Sprinkler Spacing

There must be at least 18 inches between sprinklers and any materials below them. Interference to any sprinkler is not permitted.

Fixed Extinguishing Systems

This section applies to all fixed extinguishing systems, except for automatic sprinkler systems. A fixed system that can expose you to injury, death or health consequences caused by the extinguishing agent when operated is also covered.

Some fixed extinguishing systems can use dry chemical, gaseous agents, water spray and foam.

General Requirements

Fixed extinguishing system components and agents are designed for use on specific fire hazards that they are expected to control.

If the system doesn't work, your employer will notify you and make the necessary temporary precautions to make sure of your safety until the system is fixed.

When you can't see exactly where an extinguishing agent is discharge, an alarm or signaling system that can be heard above normal work noise or light levels is provided.

Safeguards are provided to warn you against entry into discharge areas where the atmosphere remains hazardous to employee safety or health. Hazard warning or caution signs are posted at the entrance to, and inside of, areas protected by systems that use agents in hazardous concentrations.

Total Flooding Systems with Potential Health and Safety Hazards to Employees

Your employer provides an emergency action plan for each area protected by a total flooding system that provides agent concentrations exceeding safe levels.

All systems have a pre-discharge alarm that is capable of being heard above light or noise levels. This is to give you time to safely exit from the discharge area prior to discharge.

Automatic actuation of the system is provided by a fire detection interconnection with the pre-discharge employee alarm system.

Dry Chemical

This section applies to all fixed systems using dry chemical as the extinguishing agent. Dry chemical agents are compatible with any foams or wetting agents that they are used with.

When dry chemical discharge can block your vision, a pre-discharge employee alarm is provided to give you time to safely exit from the discharge area prior to system discharge.

The rate of application of dry chemicals is designed so that the concentration of the discharge agent will be reached within 30 seconds of initial discharge.

Gaseous Agent

This section applies to all fixed extinguishing systems, using a gas as the extinguishing agent. With total flooding systems, a pre-discharge alarm is used for Halon or carbon dioxide systems. The alarm provides you time to safely exit the discharge area prior to system discharge.

For total flooding systems using Halon:

Where egress from an area takes more than one minute, agent concentrations of more than 7 percent must not be used.

Where egress takes longer than 30 seconds, but less than one minute, concentrations are limited to 10 percent.

Concentrations greater than 10 percent are only permitted in areas not normally occupied; assuming any employee in the area can escape within 30 seconds.

Water Spray and Foam

This section applies to all fixed extinguishing systems that use water or foam solution as the extinguishing agent. Foam and water spray systems are designed to be effective in at least controlling fire in the protected area or on protected equipment.

Drainage of water spray systems is directed away from areas where you are working and no emergency egress is permitted through the drainage path.

Fire Detection Systems

Maintenance and Testing

All systems are maintained in an operable condition except during repairs or maintenance. Fire detectors and fire detection systems are tested and adjusted as often as needed to maintain proper reliability and operating condition.

Servicing, maintenance and testing of fire detection systems must be performed by a trained person knowledgeable in the operations and functions of the system.

Protection of Fire Detectors

Fire detection equipment installed outdoors must be protected from corrosion. Detection equipment must be protected from mechanical or physical impact.

Response Time

Fire detection systems installed for actuating fire extinguishing or suppression are designed to operate in time to control or extinguish a fire.

Detection systems installed for an employee alarm and evacuation provide a warning for emergency action and safe escape of employees.

Number, Location and Spacing of Detectors

The number, location, and spacing of fire detectors are based on data from field experience, or tests, engineering surveys, manufacturer's recommendations, or a recognized testing laboratory listing.

Employee Alarm Systems

This section applies to all emergency employee alarms. An employee alarm system provides warning for emergency action or for the reaction time for safe escape of employees.

The employee alarm is capable of being heard above noise or light levels by all employees in the affected portions of the workplace.

The alarm is distinctive and recognizable as a signal to evacuate the work area or to perform actions designated under the emergency action plan.

Your employer will explain to you how to report emergencies, such as manual pull box alarms, public address systems, radio or telephones.

Maintenance and Testing

All employee alarm systems are maintained in operating condition except when undergoing repairs or maintenance.

A test of the reliability and adequacy of non-supervised employee alarm systems is made every two months.

All Supervised employee alarm systems are tested at least annually for reliability and adequacy.

Servicing, maintenance and testing of systems must be done by trained people in the design operation and functions necessary for reliable and safe operation of the system.

Manual Operation

Manually operated actuation devices for use in conjunction with employee alarms must be unobstructed, conspicuous and readily accessible.

Summary

During this lesson, you have learned about "Means of Egress", the method of escape and evacuation. You also learned about general and specific safety rules and the requirements for providing and marking access to exits, and exit discharge for occupants of buildings. As you have seen from some of the tragedies that have occurred over the years, inadequate egress is often responsible for more deaths and injuries than the original emergency.

Lesson 2 dealt with safety in your work relating to **fires** and **exits**. This included:

- Emergency exit safety
- Exit markings and signs
- Lighting and handicap escapes

- Sprinklers, extinguishers and hoses
- Fire detection and alarms
- Emergency exit plans
- Protective equipment

In addition, you found out how to protect yourself and others from **explosions, earthquakes, smoke, toxic vapors, bomb threats, storms and floods**. Each section actually does apply to each of the kinds of disasters, just as they do for fire safety.

This lesson was all about your concern for the protection of people, not the building.

A detailed outline of Lesson 2 summarizes each area that you learned as follows:

A. General Requirements

1. Application
2. Basic Requirements
3. Construction and Repair
4. Maintenance

B. Means of Egress Contents

1. Parts of an Exit
2. Fire Resistance of Exits
3. Size of Means of Egress
4. Capacity and Occupant Load of Means of Egress
5. Arrangement of Exits
6. Access to Exits
7. Exterior Routes of Exit Access
8. Evacuation from Exits
9. Headroom
10. Changes in Elevation
11. Maintenance and Obstacles
12. Decorations

13. Fire Protection

14. Exit Signs

C. Emergency and Fire Prevention Plans

1. Emergency Action Plan

2. Fire Prevention Plan

D. Portable Fire Suppression Equipment

1. Fire Classifications

2. Extinguisher Types

E. Fire Brigades

1. Organization

2. Training and Education

3. Fire Fighting Equipment

4. Protective Clothing

5. Respiratory Protection Devices

F. Portable Fire Extinguishers

1. General Requirements

2. Selection and Location

3. Training and Education

G. Standpipe and Hose Systems

1. Standpipe Equipment and Protection

2. Maintenance

H. Automatic Sprinkler Systems

1. Water Supplies

2. Sprinkler Spacing

I. Fixed Extinguishing Systems

1. General Requirements

2. Total Flooding Systems with Potential Health and Safety Hazards to Employees

3. Dry Chemical
4. Gaseous Agent
5. Water Spray and Foam

J. Fire Detection Systems

1. Maintenance and Testing
2. Protection of Fire Detectors
3. Response Time
4. Number, Location and Spacing of Detectors

K. Employee Alarm Systems

1. Maintenance and Testing
2. Manual Operation

Lesson 2 Test – Means of Egress/Fire Protection

1. **The purpose of fire drills at school is to:**
 - a) Help your class get the award for following directions.
 - b) Let the older kids get a break from their classes.
 - c) Learn emergency exit safety.
 - d) Learn about Fire Department equipment.
2. **The “means of egress” means:**
 - a) A way to exit from buildings.
 - b) The way a fire detector warns you of smoke.
 - c) The way to escape from threats of terrorist groups.
 - d) Poor visibility due to toxic chemicals.
3. **Safety rules apply to all buildings, new or old, that are intended for people. Which rule does not apply?**
 - a) Buildings have exits that allow your quick and easy escape in an emergency.
 - b) Exits and safeguards can't depend on any single safeguard only.
 - c) Buildings are designed with locks on doors to protect people from emergencies.
 - d) Building structures are not allowed to cause danger to people during escape.
4. **A means of egress consists of three separate and distinct parts. Which part does not apply?**
 - a) The ways of exit access.
 - b) The exit sign.
 - c) The exit.
 - d) The way of exit discharge.

5. When an exit is protected by separation from other parts of the building, the separation meets all of the following safety rules except which one?
- a) Three stories or less have one hour fire resistance.
 - b) Four stories or more have four hour fire resistance.
 - c) Openings are protected by approved self-closing fire doors.
 - d) Openings in enclosed area exits are limited to access to the enclosed area from normally occupied spaces and for egress from the enclosed area.
6. The emergency action plan is in writing, except for employers with less than 10 employees. Which item below is not part of an emergency action plan?
- a) Escape procedures and escape route assignments.
 - b) Procedure to keep track of all employees.
 - c) Means of reporting fires and emergencies.
 - d) A floor plan that indicates where all fire detectors and extinguishers are located.
7. Fire brigades do not apply to which type of emergency?
- a) Industrial fire department rescues.
 - b) Private or contractual fire departments.
 - c) Portable fire extinguishing equipment use.
 - d) Airport crash rescue and forest fire fighting.
8. Portable fire extinguisher safety rules include all items below except for:
- a) Extinguishers maintained in a fully charged and operable condition and kept in their designated place.
 - b) Approved extinguishers that are provided for employee use.
 - c) Extinguishers applying to all small hose, Class II and Class III standpipe systems.
 - d) Extinguishers selected and located based on the classes of potential workplace fires and on the hazard.

9. Automatic sprinklers provide discharge patterns, densities, and water flow for complete coverage. Which rule below is not true?

- a) Every automatic sprinkler system has at least one automatic water supply.
- b) A water supply is capable of providing water flow for at least 30 minutes.
- c) There must be at least 18 inches between sprinklers and any materials below them.
- d) All automatic sprinklers are capable of spraying water for a distance of more than 50 feet.

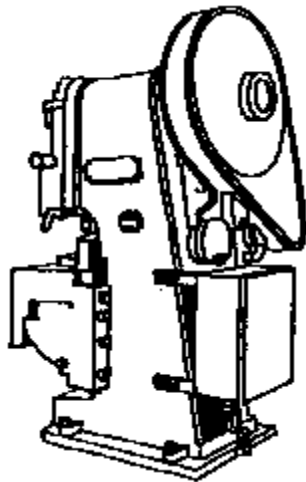
10. Fire detectors and fire detection systems are tested and adjusted as often as needed to maintain proper reliability and operating condition. Which statement below is false?

- a) Servicing, maintenance and testing of fire detection systems must be performed by a trained person knowledgeable in the operations and functions of the system.
- b) Fire detection equipment installed outdoors must be protected from corrosion and protected from mechanical or physical impact.
- c) Detection systems installed for an employee alarm and evacuation provide a warning for emergency action and safe escape of employees.
- d) The employee fire detector is capable of being heard above noise or light levels by all employees in the affected portions of the workplace.

3. Machine Guarding

Introduction

It is important that you understand machinery and safety in the workplace. In **Lesson 3** you learn about machine guards and why they are placed around certain parts of each machine. You don't want to cut off a hand or foot, or get pinched from moving parts.



Purpose

Objectives

In order to understand the safety rules about machinery, it is important to understand the meaning of the machinery terms in this section.

Outcomes

After completing Lesson 3, you will understand machine guarding, including the anchoring of fixed machinery. You will also know the safety rules about woodworking machinery such as machine controls and equipment, and specific machine safety requirements. In addition, you will have an understanding about abrasive wheel machinery; mechanical power presses and transmissions.

Quiz

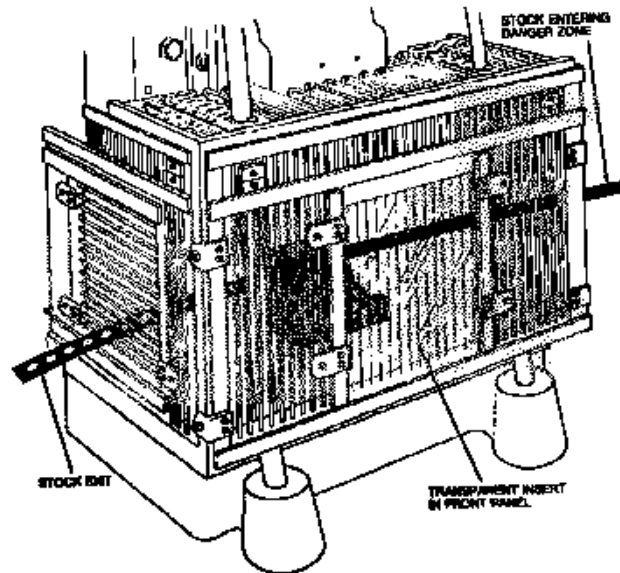
1. Machine guards protect you from:
 - A) Loud noises.
 - B) Electric shock.
 - C) Moving parts.
 - D) Toxic gas.

2. Woodworking machines have:
 - A) Exhaust fans.
 - B) Start and stop controls.
 - C) Extension cords.
 - D) Fuses.

3. Abrasive wheels:
- A) Are made of small particles.
 - B) Are the same as wire and buffing wheels.
 - C) Are made of sandpaper.
 - D) Are used for balancing tires.

Machine Guarding

One or more methods of machine guarding are provided to protect you in the machine area from hazards such as point of operation, in-going nip points, rotating parts, flying chips and sparks.



Guards are attached to the machine and secured. A guard shouldn't be an accident hazard in itself.

Any point of operating machines where you can be exposed to injury is guarded.

Revolving drums, barrels and containers are guarded by an enclosure that is interlocked with the drive mechanism.

When the surface of the blades on a fan is less than 7 feet above the floor or working level, the blades are guarded.

Anchoring Fixed Machinery

Machines designed for a fixed location are anchored to prevent walking or moving.

Woodworking Machinery

Each machine is constructed to be free from vibration when the largest size tool is mounted and run idle at full speed.

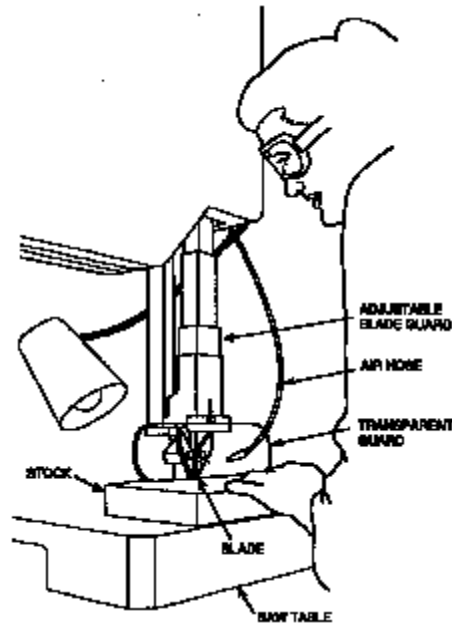
Machine Controls and Equipment

A mechanical or electrical power control is provided on each machine to make it possible for you to cut off the power from each machine without leaving your position at the point of operation.

Where you might get injured if a motor were to restart after power failures, protection is made to prevent the machine from automatically restarting when the power is restored.

Power controls and operating controls are located in easy reach while you are at your regular work location, making it unnecessary for you to reach over the cutter to make adjustments. (This does not apply to constant pressure controls that are used only for setup purposes.)

Specific Machine Safety Requirements



There are safety rules for guarding specific woodworking machines. Some of these requirements are:

All woodworking machinery such as table saws, swing saws, radial saws, band saws, jointers, boring and mortising machines, shapers, planers, lathes, sanders, veneer cutters, and other woodworking machinery are guarded to protect you and other employees from hazards while operating.

Table Saws

Circular table saws have a hood over the portion of the saw above the table, mounted so that the hood automatically adjusts itself to the thickness of the material being cut.

Circular table saws have a spreader lined up with the blade, no more than one-half inch behind the largest blade mounted in the saw. A spreader is not required for grooving, dados, or rabbits.

Circular table saws used for ripping have non-kickback fingers or dogs.

Feed rolls and blades of self-feed circular saws are protected by a hood or guard to prevent your hand from coming into contact with the in-running rolls at any point.

Swing or Sliding Cut-Off Saws

All cut-off saws have a hood that completely encloses the upper half of the saw.

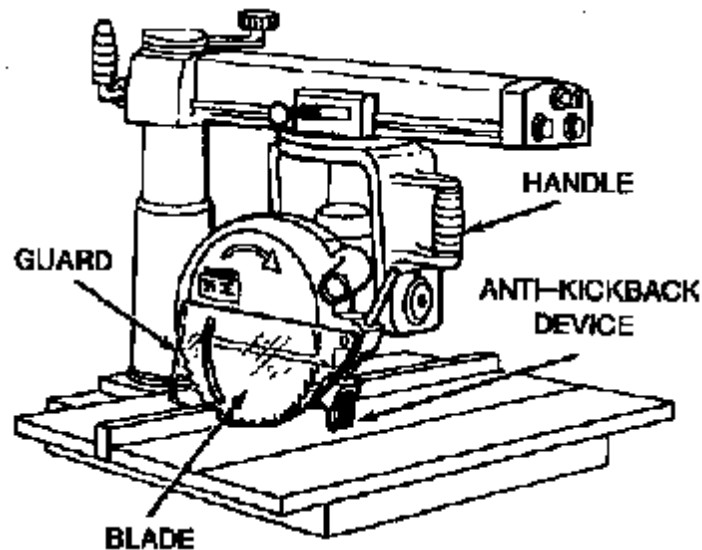
Limit stops are provided to prevent swing or sliding type cut-off saws from extending beyond the front or back edges of the table.

Each swing or sliding cut-off saw has a device to return the saw automatically to the back of the table when released at any point of its travel.



Inverted sawing or swing cut-off saws have a hood that covers the part of the saw that protrudes above the top of the material being cut.

Radial Saws



The upper hood is enclosed so that the upper portion of the blade includes the end of the saw arbor.

The sides of the lower exposed portion of the blade is guarded to the full diameter of the blade by a device that will automatically adjust itself to the thickness of the stock and remain in contact with stock being cut.

Radial saws used for ripping have non-kickback fingers or dogs.

An adjustable stop is provided for the forward travel of the blade beyond the position necessary to complete the cut in repetitive operations.

The front end of the unit is slightly higher than the rear so that the cutting head returns gently to the starting position when you release it.

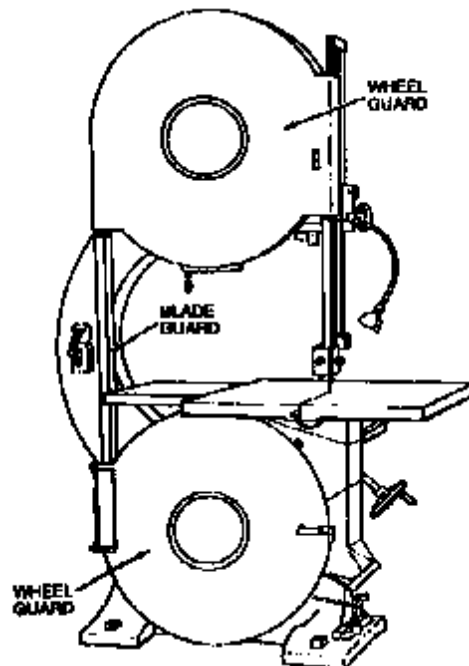
Bandsaws

All portions of the saw blade are guarded, except for the working portion of the blade between the bottom of the guide rolls and the table.

Bandsaw wheels are fully encased. The outside surface of the enclosure is solid. The front and back are solid, wire mesh or perforated metal.

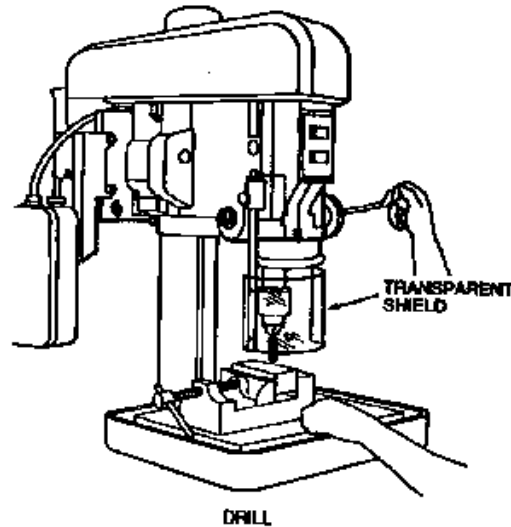
Jointers

Each hand-fed jointer with horizontal cutting head is equipped with an automatic guard that covers all the section of the head on the working side of the fence or gage.



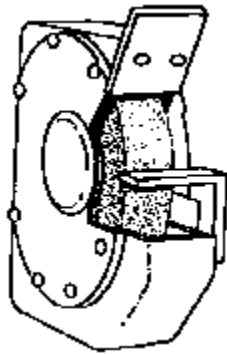
Miscellaneous Woodworking Machines

Other woodworking machines have guards and exhaust hoods to reduce hazards due to the point of operations of these machines.



Abrasive Wheel Machinery

An abrasive wheel is made up of individual particles that are bounded together to form a wheel. (They do not include wire wheels or buffing wheels.) If not properly mounted and used the wheel can actually explode! Sections of the wheel can fly out at high speeds and can hit you causing death or serious injury.



Machine Guarding

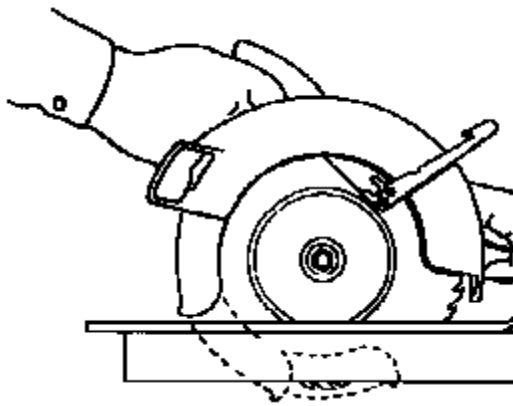
Abrasive wheels are used only on machines provided with safety guards with the following exceptions:

- Wheels used for internal work inside the work being ground;
- Mounted wheels, used in portable operations that are 2 inches or smaller in diameter; and
- Cones, plugs, and threaded hole pot balls where the work offers protection.

Guard Design

Abrasive wheel safety guards cover the spindle end, nut and flange projections, except:

- Safety guards on all operations where the work provides protection to you can be made so that the spindle end, nut, and other flange are exposed;



- Where the work entirely covers the side of the wheel, the side covers of the guard can be missing; and
- The spindle end, nut, and other flange can be exposed on machines designed as portable saws.

Work Rests

On offhand grinding machines, an adjustable work rest is used to support the work. Work rests are kept adjusted close to the wheel with a maximum opening of 1/8 inch to prevent the work from being jammed between the wheel and the rest, which can cause it to break.

Angular Exposure

Abrasive wheel safety guards for bench and floor stands, and for cylindrical grinders can't be exposed to the outside of the grinding wheel for more than 65 degrees above the horizontal plane of the wheel spindle.

Exposure Adjustment

The protecting part of the abrasive wheel safety guard is adjustable for variations of wheel size so that the distance between the wheel and the adjustable tongue or the end of the part at the top doesn't exceed 1/4 inch.

Mounting

Before mounting, you must inspect all wheels to make sure they have not been damaged.

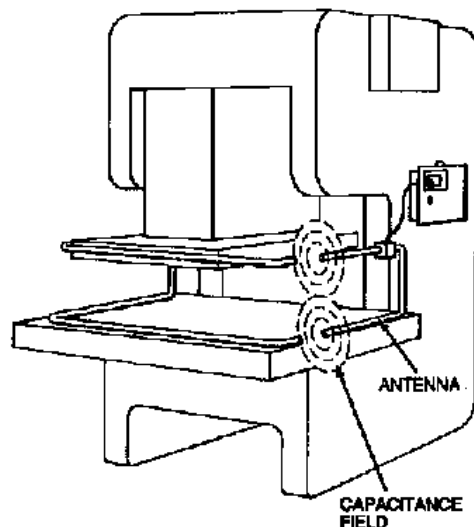
The spindle speed of the machine must be checked before mounting of the wheel to be certain that it does not exceed the operating speed marked on the wheel.

Mechanical Power

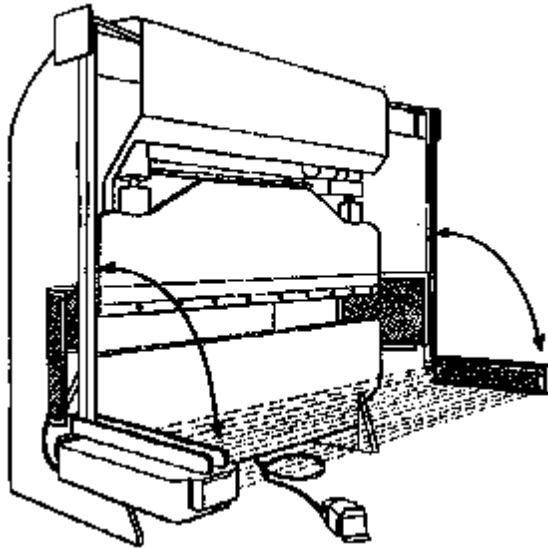
Presses

Mechanical power presses are specialized. There are basic safety rules that may apply in your workplace:

- Your employer provides point-of-operation guards to prevent hands or fingers to get into the machine by reaching



through, over, under and around the guard on a mechanical power press. This rule doesn't apply when the opening is less than ¼ inch.

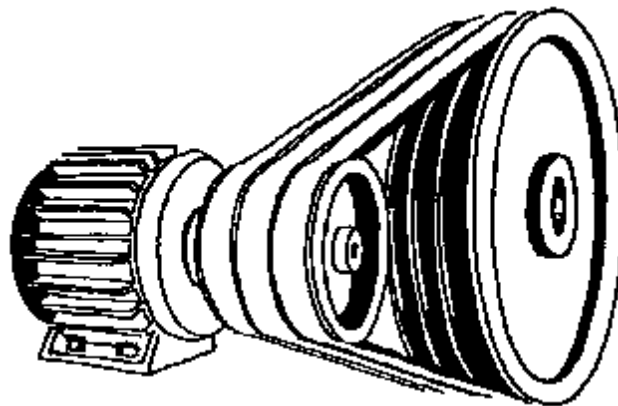


inspections and maintenance work.

- A guard is put over the treadle on foot-operated presses.
- Pedal counterweights, when provided on foot-operated presses, have the paths of the travel of the weight closed.
- Machines using full revolution clutches have a single stroke mechanism, except where automatically fed in continuous operation, and the points of operation are guarded by a fixed barrier guard.
- Your employer has regular inspections of power presses to make sure that they are in a safe operating condition, and have a record of inspections and maintenance work.
- All point-of-operation injuries must be reported to OSHA or the State agency within 30 days.

Transmissions

Mechanical power transmissions refer to all parts of the mechanical system that transmit energy from the prime mover (power source) to the part of the machine doing the work. These parts include flywheels, pulleys, belts, connecting rods, shafting, couplings, cams, spindles, chains, cranks and gears. These safety rules are to make sure that you can't be injured from being caught by rotating parts, in-running nip points, sprockets or pulleys.

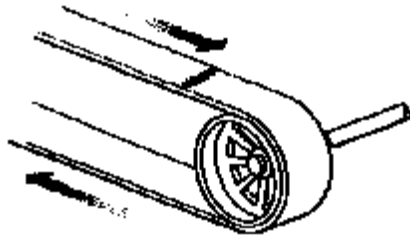


This section contains has detailed requirements for the safety of all these mechanical power transmission components. Some of these are discussed below.

Guards for mechanical power transmission equipment are made of metal or other material. Wood guards can be used in the wood working and

chemical industries, in industries where atmospheric conditions would deteriorate metal guards, or where temperature extremes make metal guards undesirable.

All pulleys, belts, sprockets and chains, flywheels, shafting and shaft projections, gears, and couplings, or other rotating or reciprocating parts within 7 feet of the floor or working platform must be effectively guarded.



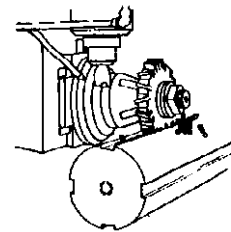
All guards for inclined belts follow the standards for horizontal belts, and are arranged so that a minimum clearance of 7 feet is maintained between the belt and floor at any point outside the guard.

Flywheels protruding through a working floor are also guarded.

Where both runs of horizontal belts are less than 7 feet from the floor or working surface, the guard extends at least 15 inches above the belt.

Where gears require a guard, the guard extends 6 inches above the mesh point by a band guard covering the face, or is completely closed.

Coupling with bolts, nuts or setscrews extending beyond the flange of the coupling are guarded by a safety sleeve.



Belts, pulleys, and shafting located in rooms used exclusively for power transmissions don't have to be guarded under the following conditions:

- The basement, tower, or room occupied by transmission equipment is locked against unauthorized entrance;
- The vertical clearance in passageways between the floor and power transmission beams, ceiling, or any other objects is not less than 5 feet 6 inches;
- The intensity of light meets safety requirements;
- The route followed by the oil is protected to prevent accidents.

Summary

A detailed outline of Lesson 3 summarizes each area that you learned as follows:

A. Machine Guarding

1. Anchoring
2. Fixed Machinery

B. Woodworking Machinery

1. Machine Controls and Equipment
2. Specific Machine Safety Requirements

C. Abrasive Wheel Machinery

D. Mechanical Power

1. Presses

2. Transmissions

Lesson 3 Test – Machine Guarding

1. **Machine guarding is provided to protect you from the safety hazards listed below except for which one:**
 - a) Point of operation.
 - b) Adjusting points.
 - c) Rotating parts.
 - d) Flying chips and sparks.
2. **Machines designed for a fixed location are anchored to prevent:**
 - a) Walking or moving.
 - b) Tipping over.
 - c) Vibration.
 - d) Blocking an exit.
3. **Each woodworking machine is constructed to provide safety protection. Which item below is not provided?**
 - a) Protection from vibration when the largest size tool is mounted and run idle at full speed.
 - b) A mechanical or electrical power control.
 - c) Automatic shut-off controls when a force greater than the machine rating is applied.
 - d) Protection to prevent the machine from automatically restarting when the power is restored.
4. **All woodworking machines, except for which one, are guarded to protect you from safety hazards while operating.**
 - a) Table saws.
 - b) Electric staplers.
 - c) Jointers.
 - d) Lathes.

5. Which of these specific machine safety requirements is false?

- a) Circular table saws used for ripping have non-kickback fingers or dogs.
- b) The upper hood of a radial saw is enclosed so that the upper portion of the blade includes the end of the saw arbor.
- c) Bandsaw wheels are fully open to allow for adjustments and dislodging objects.
- d) Each hand-fed jointer with horizontal cutting head is equipped with an automatic guard that covers all the section of the head on the working side of the fence or gage.

6. An abrasive wheel is made up of individual particles that are bounded together to form a wheel. Which of the following safety statements about abrasive wheels is false?

- a) They do not include wire wheels or buffing wheels.
- b) If not properly mounted and used an abrasive wheel can actually explode!
- c) The protecting part of the abrasive wheel safety guard is fixed for the wheel size distance between the wheel and the adjustable tongue.
- d) Sections of the wheel can fly out at high speeds and can hit you causing death or serious injury.

7. Before mounting, you must inspect all abrasive wheels to make sure that all of the following safety requirements are met, except for which one?

- a) They have not been damaged.
- b) The abrasive wheel is at least $\frac{3}{4}$ inch in diameter.
- c) The spindle of the machine must be checked.
- d) The machine doesn't exceed the operating speed marked on the wheel.

8. Which basic safety rule about a mechanical power press does not apply?

- a) Point-of-operation guards are provided to prevent hands or fingers to get into the machine by reaching around the guard.
- b) Guards are provided when an opening is less than $\frac{1}{4}$ inch.
- c) A guard is put over the treadle on foot-operated presses.
- d) Pedal counterweights on foot-operated presses have the paths of the travel of the weight closed.

9. Which statement about machine presses is false?

- a) Machine presses using full revolution clutches have a single stroke mechanism, except where automatically fed.
- b) Your employer has regular inspections of power presses to make sure that they are in a safe operating condition, and have a record of inspections and maintenance work.
- c) A fixed barrier guard always guards the points of operation.
- d) All point-of-operation injuries must be reported to OSHA or the State agency within 30 days.

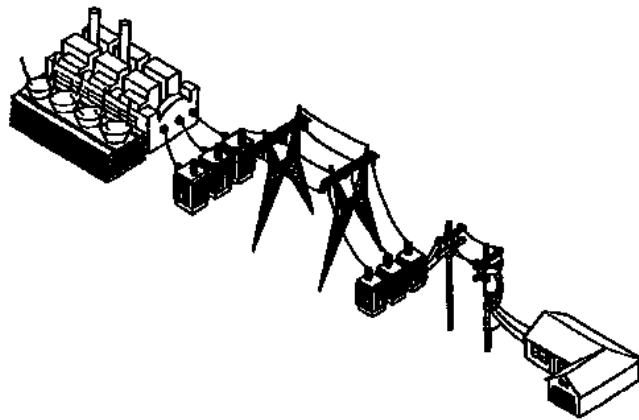
10. Mechanical power transmissions refer to all parts of the mechanical system that transmit energy from the prime mover to the part of the machine doing the work. Which of the following items is not a part of mechanical power transmissions?

- a) Flywheels.
- b) Pulleys.
- c) Machine guards.
- d) Belts.

4. Electrical

Introduction

Electricity is part of your life, both at home and at work. Engineers and electricians that do wiring, such as overhead lines, cables, or circuit assemblies work with electricity directly. Others, such as office workers and salespeople, work with it indirectly. As a source of power, electricity isn't given much thought for it's potential hazards. Since it is a familiar part of our surroundings, it isn't treated with respect.



In 1989, in companies that had 11 or more workers, there were 3,600 work-related deaths. More than 320 of these deaths were the direct result of electrocutions at work. What makes these deaths tragic is that they could have been avoided.

Electricity has long been recognized as a serious workplace hazard, exposing employees to dangers such as electric shock, electrocution, fires and explosions. You need to know about the potential hazards and safety in using electrical equipment and systems.

Electrical safety includes any electrical system that you would normally use or contact. The exposed and or operating parts of electrical systems - lighting equipment, motors, machines, appliances, switches, controls and enclosures - are designed to minimize electrical dangers to you in your workplace.

Purpose

In **Lesson 4** you learn about electrical safety, wiring, extension cord use and hazardous locations to watch out for.

Objectives

You learn how to recognize electrical safety in your workplace.

Outcomes

After completing Lesson 4, you will have a better appreciation for electrical equipment design safety and the identification for disconnecting electrical equipment and circuits. This includes the wiring protection in using and identifying grounded and grounding conductors, equipment connected by cord and plug and non-electrical equipment.

You will also be introduced to wiring methods, components and equipment for general use. This includes temporary wiring, switches, switchboards and panelboards, conductors for general wiring, flexible cords and cables and equipment for general use.

You will be able to recognize hazardous locations and electrical safety work practices of work for qualified and unqualified persons.

As part of this training, you will learn how to select and use the appropriate work practices as you do your job. These will include working on or near exposed de-energized parts, lockout and tagging, working on or near exposed energized parts, vehicular and mechanical equipment.

You will learn the safety in using portable electric equipment, electric power and lighting circuits, test instruments and other equipment. Finally, you will recognize the safeguards for personnel protection in the use of protective equipment and alerting techniques.

Quiz

1. Electrical equipment protects you from:
 - A) Corrosion.
 - B) Water.
 - C) Shocks.
 - D) Slipping.

2. Ground is:
 - A) Dirt.
 - B) Neutral.
 - C) Negative.
 - D) Vapor.

3. Which person does not need electrical safety training?
 - A) Electrician.
 - B) Painter.
 - C) Security guard.
 - D) Welder.

Electrical Equipment Design

Electrical equipment is designed to protect you from safety hazards that are likely to cause death or serious physical harm. The safety of electrical equipment uses the following considerations:

- The use of the electrical equipment for a specific purpose and labeled for that identified purpose.
- The adequacy of the protection for all parts designed to enclose and protect other equipment.
- Electrical insulation.
- Heating effects under conditions of use.
- Arcing effects.
- Classification by type, size, voltage, current capacity, and specific use.

Splices

Conductors are spliced for use in brazing, welding, or soldering with a fusible metal or alloy. All splices and joints and the free ends of conductors are covered with insulation.

Arcing Parts

Parts of electrical equipment that produce arcs, sparks, flames, or molten metal are separated and isolated from all combustible material.

Marking

Electrical equipment can't be used unless the manufacturer's name and trademark is on the equipment. Other markings are also provided giving voltage, current, wattage, and other ratings.

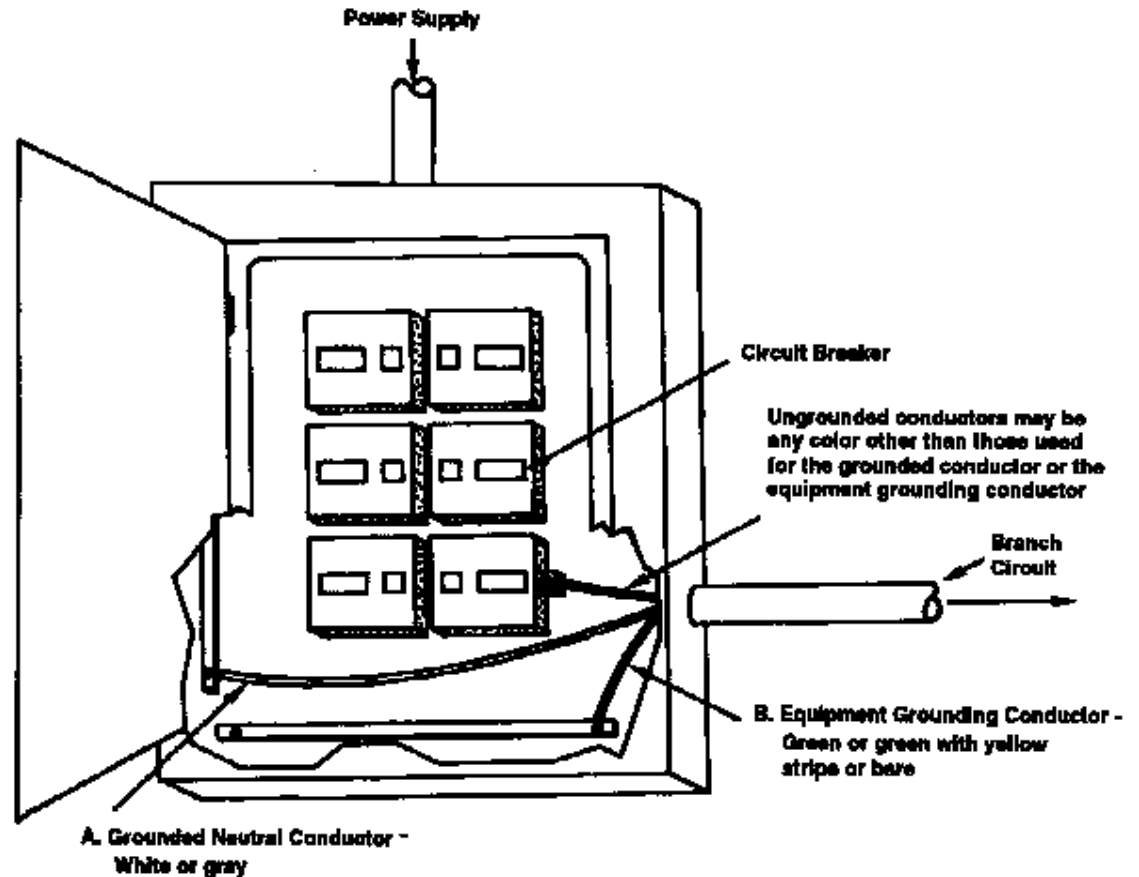
Marking is very important. If an item of equipment is connected to a voltage higher than its rating, the chances are that it will fail. If it is connected to a voltage below its rating, it can overheat and fail. If A-C equipment is energized with the wrong frequency, or with direct current, it will fail. These things can burn you and can cause fires.

If equipment is connected to the wrong circuit, conductors can overheat and deteriorate. Protective devices are designed to prevent serious damage, but if these devices have been tampered with, they will not protect you.

If the manufacturer's name is not marked on the nameplate, it is difficult to find the reasons for faulty performance and in preventing future failures. Sometimes it is necessary to know the manufacturer in order to determine if equipment is approved for a particular purpose. The manufacturer's name is also necessary so that you can get information or replacement parts.

The marking is provided on the nameplate of the equipment. It is in violation of the law when the nameplate is covered, removed, or painted over.

Identification for Disconnecting Electrical Equipment and Circuits



The disconnecting means for motors and appliances is marked to indicate its purpose, unless the purpose is evident. This includes each service, feeder, and branch circuits.

A disconnecting means is a switch that is used to disconnect the equipment from the source of electricity. Disconnect switches are important because they let you open a circuit, stopping the flow of electricity, to protect you and the equipment.

Each disconnect switch is labeled to indicate the circuit's use, and the label is located where the circuit begins. For example, on a panel that controls several motors or on a motor control center, each disconnect is marked to indicate the motor that each circuit is connected to.

600 Volts or less

Electrical Equipment Working Space

This section is about the safety of a *person qualified to work on the equipment* (like an electrician). Hazards are treated in different ways for people that remove guards and enclosures and actually work on the live parts. Access and working space is provided for all electrical equipment to permit safe operation and maintenance of equipment. This space must be kept clear at all times.

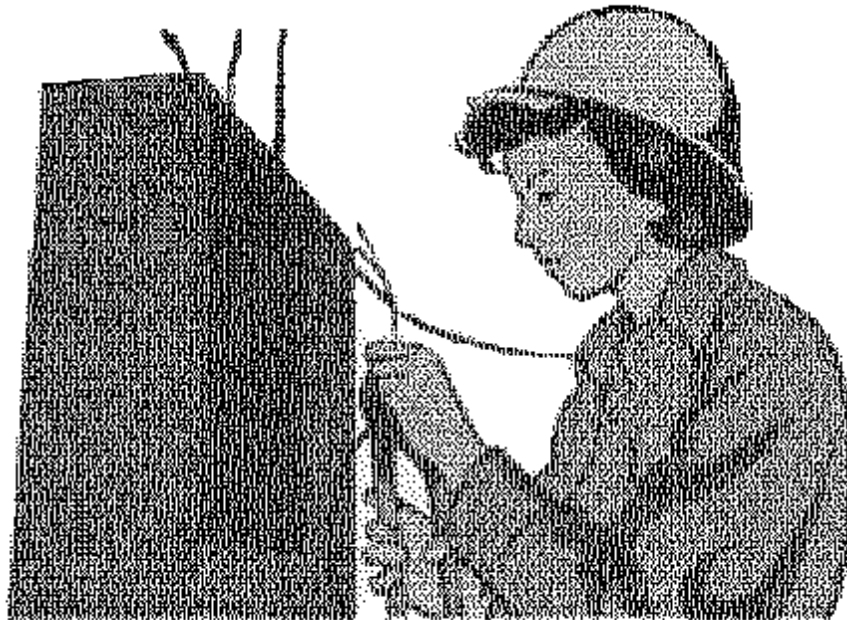
Working Clearances

Workspace can't be less than 30 inches wide in front of electrical equipment. Concrete, brick, or tile walls are treated as grounded. Working space isn't required behind equipment that has no parts such as fuses or switches on the back.

Working spaces can't be used for storage, the working space has to be maintained, and lighting and headroom must be available.

Protection from Live Parts

Protection must be available to *any person* who can be in contact with electrical equipment. This protection is for all people including those that are not electricians working on the equipment, and aren't qualified or trained to work with live parts.



Live parts of electric equipment that are 50 volts or more are guarded against accidental contact by approved cabinets, or by the following means:

- By location in a room or vault that is accessible only to qualified persons.
- By permanent partitions or screens that only qualified people can access to reach live parts.
- By location on a balcony or platform.
- By elevation of 8 feet or more above the floor or other working surface.

600 Volts or more

Enclosure for Electrical Installations

Electrical installations in a vault, room, closet or in any area surrounded by a wall, screen or fence, and controlled by lock and key, are considered accessible to qualified employees only. A wall, screen, or fence less than 8 feet high doesn't prevent access unless it has other features that provide isolation similar to an 8-foot fence. The entrances to all buildings, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 volts are kept locked or must be under the observation of a qualified person at all times.

Equipment Workspace

Electrical installations that have exposed live parts are accessible to qualified people only. Space is provided around electrical equipment to allow safe operation and maintenance of the equipment. Where energized parts are exposed, the minimum clear workspace can't be less than 3 feet wide in front of the electrical equipment.

Lighting

Lighting is provided for all working spaces around electrical equipment. The lighting outlets are arranged so that changing lamps or making repairs on the lighting doesn't put you in danger by live parts or other equipment. Controls are located so that you won't contact live or moving parts of the equipment while turning on the lights.

Entrance and Access to Workspace

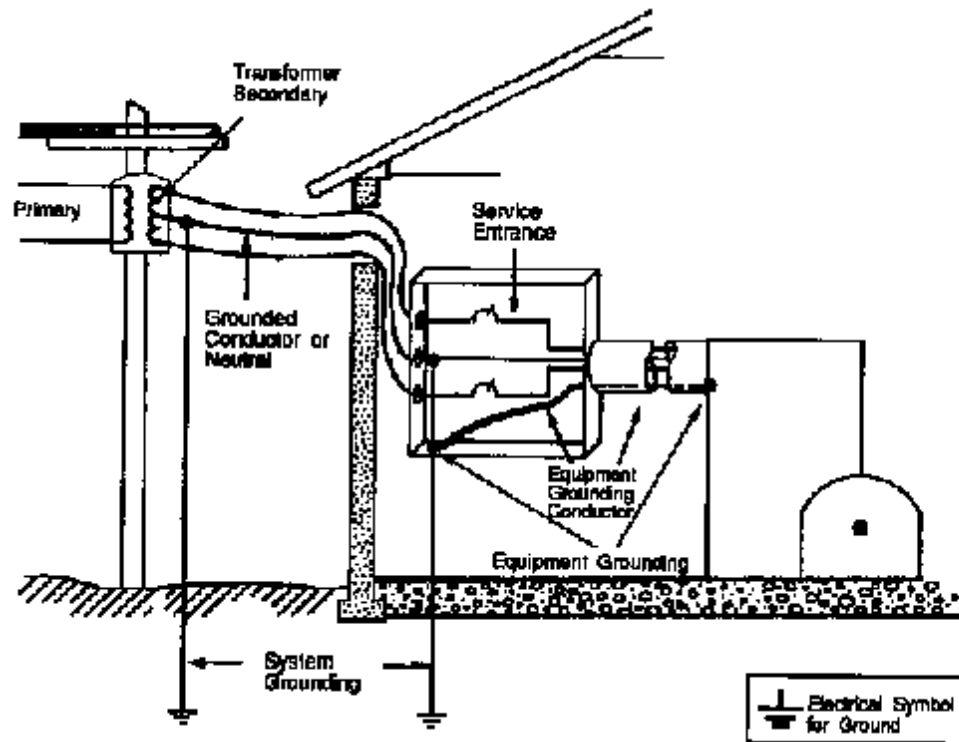
At least one entrance is provided to give access to the working space around electrical equipment. Permanent ladders or stairs are provided for safe access to the working space around electrical equipment installed on platforms, balconies, mezzanine floors, or in attic or roof rooms or spaces.

Wiring Protection

Use and Identification of Grounded and Grounding Conductors

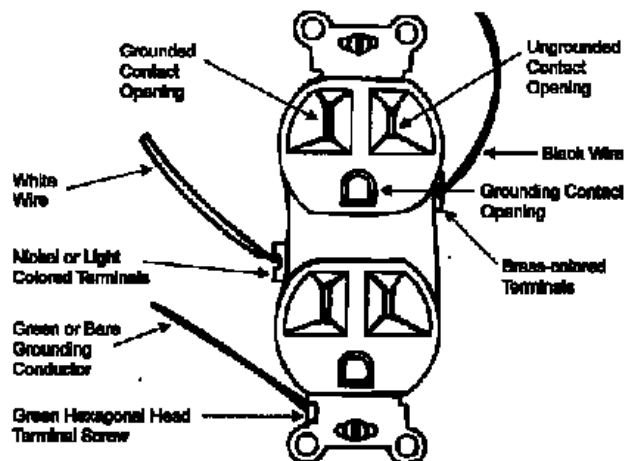
The grounded conductor is an energized circuit conductor that is connected to earth through the system ground. It is commonly referred to as the *neutral*. The equipment-grounding conductor isn't an energized conductor. The equipment-grounding conductor

acts as a safeguard against insulation failure or faults in the other circuit conductors. The equipment-grounding conductor is energized *only* if there is a leak or fault in the normal current path, and it directs this current back to the source. Directing the fault current back to the source let's circuit breakers or fuses operate to prevent fires and reduce the hazard of electrical shocks.



The grounded and equipment grounding conductors of an electrical circuit are marked or color coded to allow employees to identify them and tell them apart from each other and from the other conductors in the circuit.

The *National Electrical Code* states: "The grounded conductor of a branch circuit must be identified by a continuous white or natural gray color." Also, "The equipment grounding conductor of a branch circuit must be identified by a continuous green color or a continuous green color with one or more yellow stripes unless it is bare." Bare copper or aluminum wire is permitted for use as a grounding conductor.



Polarity of Connections

No grounded conductor can be attached to any terminal or lead to reverse the designated polarity.

Use of Grounding Terminals and Devices

A grounding terminal or grounding-type device on a

receptacle, cord connector, or attachment plug can't be used for purposes other than grounding.

Reversed Polarity

The polarity of connections and use of grounding terminals show one potentially dangerous aspect of alternating current: many pieces of equipment will operate properly even though the supply wires are not connected in the order designated by design or the manufacturer. Improper connection of these conductors is usually found on smaller circuits with standard 120 volt outlets, lighting fixtures and cord- and plug-connected equipment.

When plugs, receptacles, and connectors are used in an electrical branch circuit, correct polarity between the ungrounded (hot) conductor, the grounded (neutral) conductor, and the grounding conductor must be maintained.

Reversed polarity is a condition when the circuit conductor (the grounded conductor or neutral) is incorrectly connected to the ungrounded or "hot" terminal of a plug, receptacle, or other type of connector.

Services

Means is provided to disconnect all conductors in a building from the service-entrance conductors. The disconnecting means plainly indicates whether it is in the open or closed position and it is located at a location near the entrance.

The service entrance is the location where the service conductors enter a building. The disconnecting means can be a switch or circuit breaker. This will disconnect the electrical equipment in the building in case of an emergency.

Services Over 600 Volts

Warning signs for high voltage are posted where employees might be exposed to live parts.

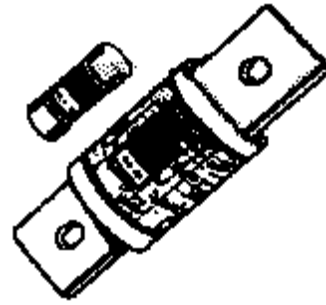
Protection of 600 Volts or Less Conductors and Equipment

Electric current is the flow of electrons through a conductor. The size of the wire is the main factor for how much current that can safely flow through a conductor. The larger the wire, the more current can flow safely. If too much current flows through a conductor, excess heat is produced. If the circuit is not protected, the heat can continue to build and reach a temperature high enough to destroy insulation and cause a fire.

Fuses and circuit breakers are protective devices designed to disconnect a circuit from its source of supply when a maximum heat level is reached. The basic idea of a protective device is to make a weak link in the circuit. In the case of a fuse, the fuse is destroyed before another part of the system is destroyed. In the case of a circuit breaker, a set of contacts opens the circuit. Unlike a fuse, a circuit breaker can be re-used by re-closing the contacts. Fuses and circuit breakers are designed to protect equipment and facilities and provide protection against shock. It is important that these devices have adequate interrupting ratings to protect you from shock.

Disconnection of Fuses and Thermal Cutouts

Fuses on circuits over 150 volts to ground are provided with a disconnecting means. This disconnecting means must be installed so that the fuse or thermal cutout can be disconnected from its supply without disrupting service to equipment and circuits unrelated to those protected.



Location In or On Premises

Physical damage often results when devices are located where they can be struck by lift trucks, crane hooks or materials being handled.

Grounding

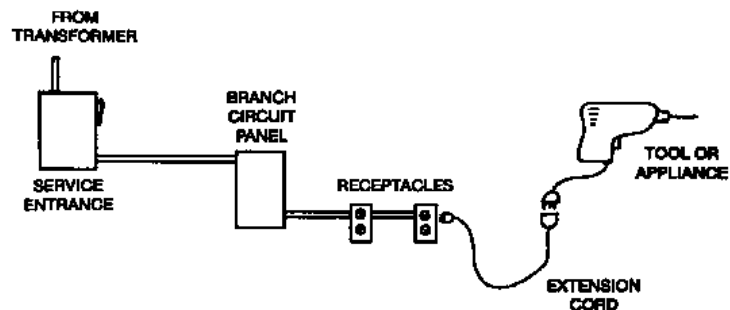
Grounding electrical circuits and electrical equipment is required to protect you from electrical shock, safeguard against fire, and protect against damage to electrical equipment. There are two kinds of grounding: (1) electrical circuit or system grounding, and (2) electrical equipment grounding. Electrical system grounding is when one conductor of the circuit is connected to earth. This is done to protect the circuit from lightning. The second kind of ground is equipment grounding. This is when all metal frames of equipment containing electrical equipment or conductors are grounded with a permanent and continuous connection. The equipment-grounding conductor provides a path for dangerous fault current to return to the system ground at the supply source of the circuit if the insulation failures.

Supports and Enclosures for Conductors

Metal cable trays, metal raceways, and metal enclosures for conductors are grounded. Frames of electric ranges, wall-mounted ovens, counter-mounted cooking units, clothes dryers, and metal outlet or junction boxes are grounded.

Equipment Connected by Cord and Plug

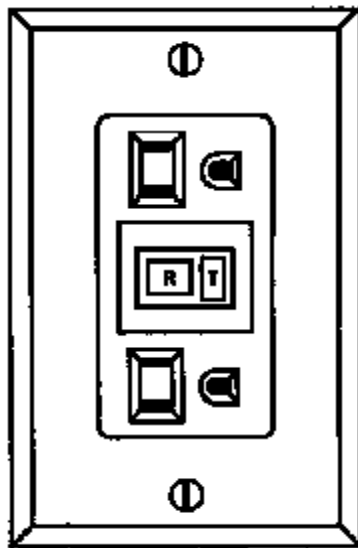
Under any of the following conditions, exposed metal parts of cord- and plug-connected equipment must be grounded.



a. If the equipment is:

- Refrigerators, freezers, and air conditioners;

- Clothes-washing, clothes-drying and dish-washing machines, sump pumps, and electrical aquarium equipment;
- Hand-held motor-operated tools;
- Motor-operated appliances like hedge clippers, lawn mowers, snow blowers, and wet scrubbers;
- Cord- and plug-connected appliances used in damp or wet locations or by employees standing on the ground or on metal floors or working inside of metal tanks or boilers;
- Portable and mobile X-ray and associated equipment;
- Tools used in wet locations; and
- Portable hand lamps.



Non-

To ground cord- and plug connected equipment; a third wire is normally provided in the cord and a third prong in the plug. The third wire is used as a grounding conductor that is connected to the metal housing of a portable tool. The third wire provides a path for a fault current if there is insulation failure.

Portable tools and appliances protected by an approved system of double insulation don't have to be grounded. This kind of equipment must be marked to indicate that the tool or appliance uses an approved system of double insulation.

Electrical Equipment

The metal parts of non-electric equipment must also be grounded. Some of these include frames and tracks of electrically operated cranes; frames of non-electronically driven elevator cars that have electric conductors; hand operated metal shifting ropes or cables of electric elevators, and metal partitions and grill work around equipment over 750 volts.

Wiring Methods, Components, and Equipment for General Use

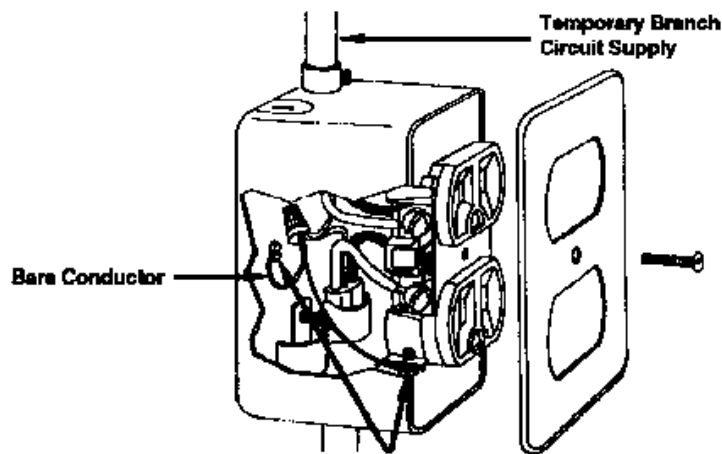
No wiring of any type is allowed in ducts used for dust or flammable vapors. No wiring of any type can be installed in any duct used for ventilation of commercial cooking equipment.

Temporary Wiring

Temporary electrical power and lighting that is 600 volts or less can be used only:

- During remodeling, maintenance, repair, or demolition of buildings, structures, or equipment;
- For experiment or development work; and
- For a period less than 90 days for Christmas decorative lighting and carnivals.

Temporary wiring over 600 volts can be used only during periods of tests, experiments, or emergencies.



Requirements for Temporary Wiring

- Receptacles used in temporary wiring must provide a connection for an equipment-grounding conductor.
- No bare conductors can be used for wiring of temporary circuits.
- Disconnecting switches or plug connectors must permit disconnection of all ungrounded conductors of each temporary circuit.
- Lamps must be prevented from accidental contact or breakage. Protection must be provided at least 7 feet from the normal working surface or by a lamp holder with a guard.
- Flexible cords and cables must be protected from accidental damage. Sharp corners and projections must be avoided. Where passing through doorways or other pinch points, flexible cords and cables must be provided with protection to avoid damage.

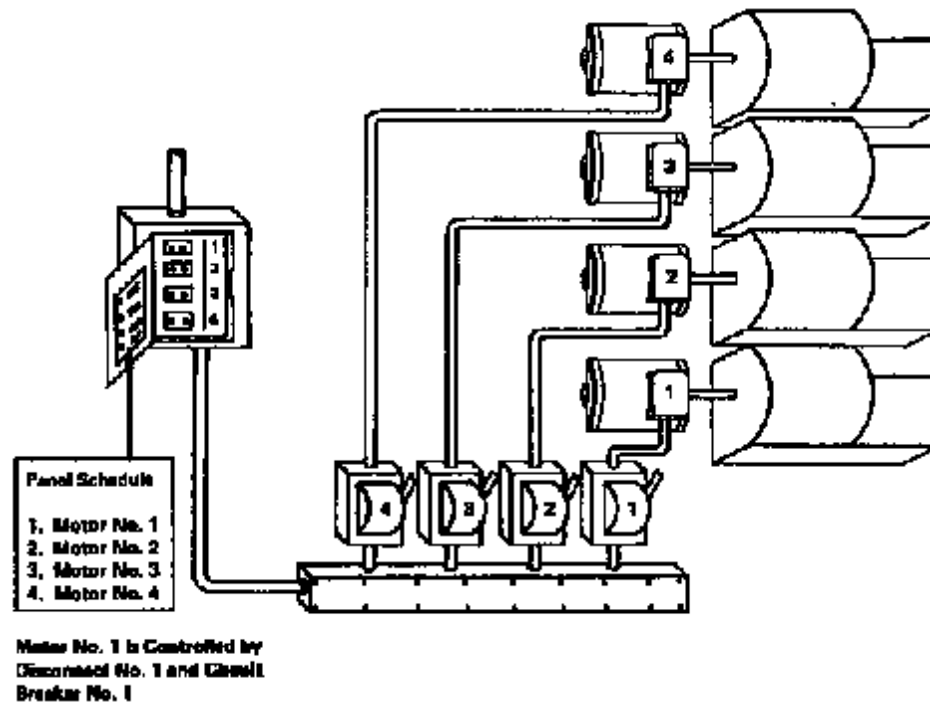
Switches

Knife Switches

Single-throw knife switches have one energized (closed or "ON") position and one open (dead or "OFF") position. The switch is designed so that when it is in the open position, the blades are not energized. The switches are installed so that if the switch falls down, it will not fall into its energized position.

Double-throw knife switches are knife switches that have two energized (closed or "ON") positions and one open (dead or "OFF") position. These switches are mounted vertically so that they are moved up and down or horizontally so they can move back and forth.

Switchboards and Panelboards



A switchboard that has exposed live parts is located in an area that is not wet or damp. The purpose of this safety rule is to reduce the chance of shock if you accidentally contact the live parts. Additionally, only qualified employees can have access to switchboards with exposed live parts. To limit access, the switchboard is in a locked room or a locked cage or fenced area. Keys to the locks are controlled to make sure that only trained personnel are allowed to enter the area.

Conductors for General Wiring

To provide adequate protection against shock and fire hazards, conductors are insulated with approved materials. Insulated conductors are easily identified and color-coding is used. Neutral, or grounded, conductors are white or natural gray.

Grounding conductors such as equipment grounding conductors are green or green with yellow stripes. Grounding conductors are permitted to be bare wires.

Flexible Cords and Cables

The safe use of flexible cords is one of the most frequently violated electrical standards, particularly in smaller companies. There is a need and place for cords, but there is also a temptation to misuse them because they seem to offer a quick and easy way to carry electricity to where it is needed. The basic problem is that flexible cords are not as safe as fixed wiring in the building. Cords should not be used if some other method is available.

Flexible cords and cables must be approved and suitable for use and location. Flexible cords and cables can only be used for:

- a. A lamp holder or cord-connector suspended by a length of cord secured and terminated directly above the suspended device;
- b. Wiring of fixtures;
- c. Connection of portable lamps or appliances;
- d. Elevator cables;
- e. Wiring of cranes and hoists;
- f. Connection of stationary equipment to assist in their frequent exchange (equipment which is not normally moved from place to place);
- g. Prevention of the transmission of noise or vibration.
- h. Appliances where the fastening means and mechanical connections are designed to allow removal for maintenance and repair (e.g. water coolers, exhaust fans);
- i. Data processing cables approved as a part of the data processing system.

Note that all of the above situations involve conditions where flexibility is necessary. Unless specifically permitted by one of these situations, flexible cords and cables can not be used:

- a. As a substitute for the fixed wiring of the structure;
- b. Where run through holes in walls, ceilings, or floors;
- c. Where run through doorways or windows;
- d. Where attached to building surfaces; or
- e. Where concealed behind building walls, ceiling, or floors.

There are usually no problems using the short cord provided with an approved appliance, tool, or for an extension cord temporarily used for an appliance or tool at some distance from a fixed outlet. But, there are questions when the use isn't obviously temporary, and when the cord is extended to some distant outlet in order to avoid providing a fixed outlet where needed.

Flexible cord used improperly is likely to be damaged by activities in the area; by door or window edges; by staples or fastenings; by abrasion from adjacent materials; or simply by aging. If the conductors become partially exposed, there will be danger of shocks, burns, or fire.

Identification, Splices and Terminations

Flexible cords must be used in complete lengths without splices. Hard flexible cords, No. 12 or larger, can be repaired so the insulation and outer sheath of the cord are spliced.

Portable Cables Over 600 Volts

Multi-conductor portable cable used for supply power to portable equipment over 600 volts consists of No. 8 or larger conductors with flexible strands. Cables over 2000 volts are shielded in to confine the voltage to the insulation. Portable cables can't be operated with splices unless the splices are molded or vulcanized. Termination ends are marked with a high voltage hazard warning and accessible only to authorized and qualified people.

Equipment for General Use

Lighting Fixtures, Lamp Holders, Lamps, and Receptacles

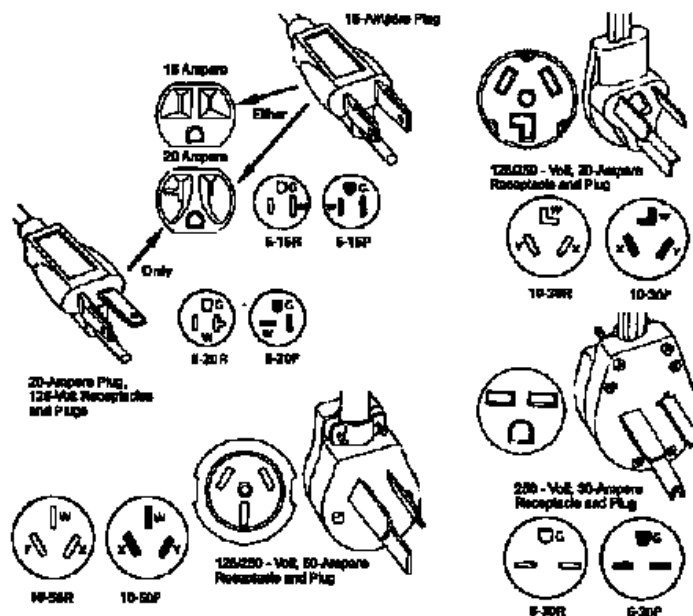
Fixtures, lamp holders, lamps, and receptacles can't have live parts exposed to employee contact. However, cleat-type lamp holders and receptacles located at least 8 feet above the floor can have exposed parts.

Portable hand lamps that have a flexible cord must have a molded handle and a guard attached to the lamp or the handle.

Screw-shell type lamp holders can only be installed for use as lamp holders and can't be used with screw-base socket adapters. These adapters screw into the existing lamp socket and convert lamp holders into receptacles. Only weatherproof lamp holders can be used in wet or damp areas. Unprotected lamp holders might allow moisture to enter the lamp holder socket, creating an electrical shock hazard.

Receptacles, Cord Connectors, and Attachment Plugs

Cord connectors join two sections of electrical cord together. Attachment plugs are fastened to the end of a cord so that electrical contact is made between the cord and the receptacle. Connectors, plugs, and receptacles are designed for different voltages and currents; so that only matching plugs will fit into the correct receptacle or cord connector.



RECEPTACLES AND PLUGS WITH NEMA CONFIGURATIONS

Appliances

Electrical appliances such as portable air conditioning units, coffee makers, and fans can't have any exposed live wires or electrical parts that might create an electric shock hazard.

Exceptions to this are appliances like space heaters and toasters that have exposed parts that operate at high temperatures. Each appliance must be marked with its rating in volts and amperes or volts and watts.

Motors

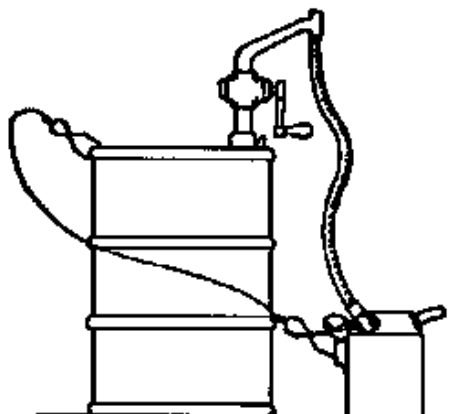
Motors, motor-controls, and motor branch-circuit conductors are protected against overheating due to motor overloads or failure to start, and against short-circuits or ground faults. They don't need overload protection that stops the motor, if that increases potential hazards, such as fire pumps, or when the operation of a motor is necessary for safe shutdown of equipment.

Protection of Live Parts - All Voltages

Stationary motors that have communicators, collectors, and brushes inside the motor and aren't connected to circuits more than 150 volts don't need their parts guarded.

Exposed live parts of motors that are more than 50 volts are guarded against accidental contact.

Where motors over 150 volts are guarded against accidental contact and adjustments are necessary during their operation, insulating mats or platforms are provided so that you can't touch live parts unless you are standing on the mats or platforms.



Transformers

The exposed live parts of transformers have warning signs on the equipment.

Dry-type, liquid-insulated transformers that are indoors and rated over 35kV are in a vault.

Oil-insulated transformers installed indoors must be in a vault if they may cause a fire hazard.

Transformer vaults are constructed to contain fire and combustible liquids in the vault and to prevent unauthorized access.

Capacitors

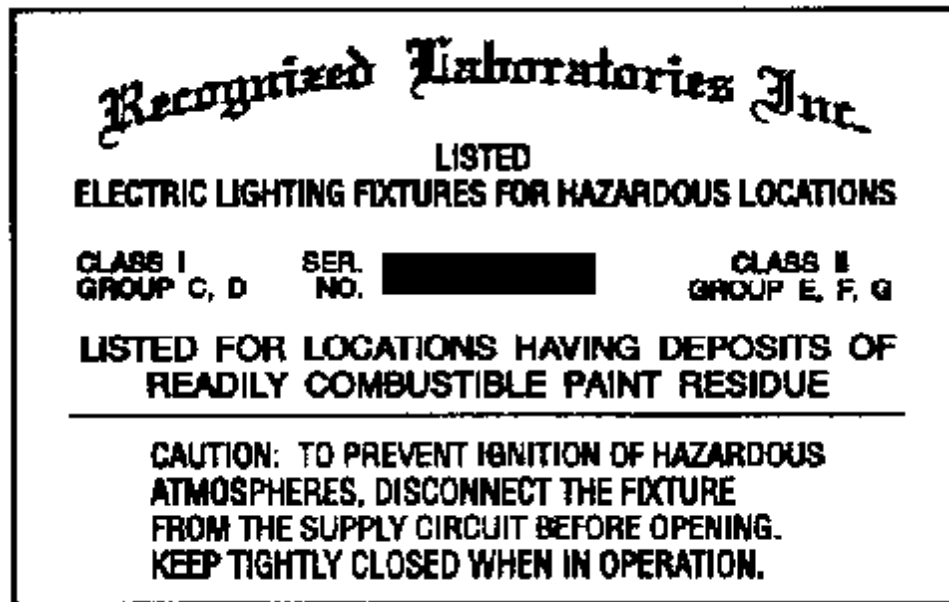
Capacitors store electrical charge and can cause severe shock unless the charge is drained when the capacitors are disconnected.

Storage Batteries

Storage batteries that are lead-acid or alkali produce explosive gases if they are overcharged. A spark or open flame could ignite the mixture and cause an explosion. Good ventilation must be provided.

Hazardous Locations

Hazardous locations have a potential for explosion and fire because of flammable gasses, vapor or dusts, or because of the presence of easily ignitable fibers. Hazardous locations can result from processing chemicals, gasses and grains. It is also possible that a hazardous location can be created when solvents or fluids, used in maintenance, vaporize to form an explosive.



Hazardous locations can be found in aircraft hangars, gasoline and service stations, bulk storage plants for gasoline or other flammable liquids, paint-finishing process plants, healthcare facilities, agricultural or other facilities where dust can be present, marinas, boat yards, and petroleum and chemical processing plants.

You must guard against ignition of these areas. No open flames are allowed in these locations. There are other potential sources of ignition, including electrical equipment. The normal operation of switches, circuit breakers, motor starters, contacts and plugs and receptacles might produce arcs and sparks.

Electrical Safety Work Practices

Work standards are in place for working near exposed parts of electrical equipment and the safe use of electrical equipment.

These rules are intended to protect you from electrical hazards that you can be exposed to. When you are working with electrical equipment, you must use safe work practices. This includes keeping a distance from exposed energized lines, avoiding the use of electric equipment when you or the equipment is wet, and locking-out and tagging equipment that is de-energized for maintenance.

Another important safety practice involves the use of electrical protection, such as rubber gloves and rubber mats for insulation against live parts, or live-line tools for insulation of energized parts.

The lockout/tagout rules safeguard you from hazardous energy while you are performing servicing or maintenance on machines and equipment.

Covered Work

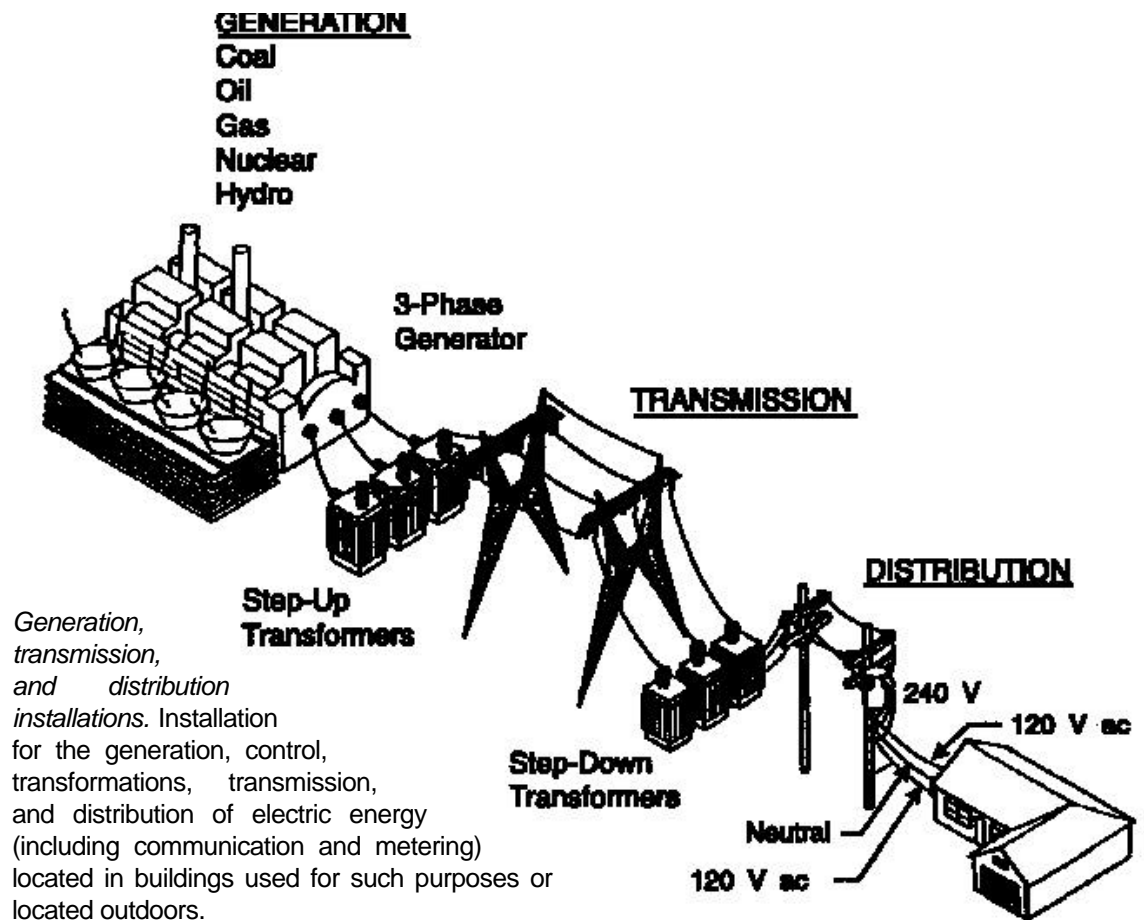
Qualified and Unqualified Persons

These standards cover electrical safety-related work practices for both the qualified (those who have training in avoiding the electrical hazards of working on or near exposed energized parts) and the unqualified (those with little or no such training) working on, or with the following:

- *Premises Wiring.* Installation of electric conductors and equipment in or on buildings, and in yards, carnival, parking, and other lots, and industrial substations;
- *Wiring for Connections to Supply.* Installations of conductors that connect to the supply of electricity; and
- *Other Wiring.* Installations of other outside conductors on the premises.
- *Optical Fiber Cable.* Installations of optical fiber cable where installations are made along with electric conductors.

Other Covered Work by Unqualified Persons

The provisions of these standards also cover work performed by unqualified people on, near, or with the following:



Communications Installations. The installation of communications equipment.

Installations in Vehicles. Installation in ships, watercraft, railway rolling stock, aircraft, or automotive vehicles other than mobile homes and recreational vehicles.

Railway Installations. Installation of railways for generation, transformation, transmission, or distribution of power used exclusively for operation of rolling stock or signaling and communication.

Excluded Work by Qualified Persons

The standards don't apply to work performed by qualified people associated with the four types of installations above.

Training

Training is provided for employees who face a risk of electric shock. Employees in occupations listed below face this risk and must be trained:

- Blue collar supervisors
- Electrical and electronic engineers
- Electrical and electronic equipment engineers

- Electrical and electronic technicians
- Electricians
- Industrial machine operator
- Material handling equipment operators
- Mechanics and repairers
- Painters
- Riggers and Roustabouts
- Stationary engineers
- Welders

With the exception of electricians and welders, workers don't need to be trained if their work doesn't bring them close enough to exposed parts of electric circuits for a hazard to exist.

Content of Training

Employees must be trained in safety work practices that pertain to their job assignments.

To be qualified, you must be trained in the following:

- The skills to recognize exposed live parts from other parts of electric equipment,
- The skills to determine the voltage of exposed live parts, and
- The clearance distances and the voltages that you will be exposed.

Type of Training

Training must be in the classroom or on-the-job. The amount of training is determined by the risk to the employee.

Selection and Use of Work Practices

Safety-related work practices must prevent electric shock or other injuries from electrical contacts when work is done near equipment or circuits that can be energized.

Live parts that you can be exposed to must be de-energized before you work on or near them. Live parts that are less than 50 volts don't need to be de-energized if there won't be exposure to electrical burns or to explosion due to electric arcs.

If exposed live parts aren't de-energized, other safety-related work practices are used to protect you.

Working On or Near Exposed De-energized Parts

This applies to work on exposed de-energized parts or near enough to them to expose you to any electrical hazard.

Electric equipment that is de-energized but isn't locked out or tagged must be treated as *energized* parts.

Lockout and Tagging

While you are exposed to contact with parts of electrical equipment or circuits that are de-energized, the circuits energizing the parts must be locked out or tagged.

1. A lock and a tag are put on each disconnecting means used to de-energized circuits and equipment.



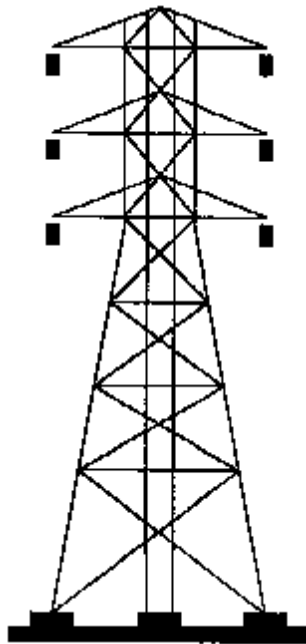
2. Each tag contains a statement that doesn't allow unauthorized operation of the disconnection means and removal of the tag.
 - a. A qualified person must conduct tests and visual inspections to verify that all tools, electrical jumpers, shorts, grounds, and other such devices have been removed so that the circuits and equipment can be safely energized again.
 - b. Employees exposed to the hazards of re-energizing the circuit or equipment must be warned to stay clear of circuits and equipment.
 - c. Locks and tags are to be removed by the person that put them there.

Working On or Near Exposed Energized Parts

This applies to work on exposed live parts involving contact with tools near enough for you to be exposed to any hazard.

Only qualified people can work on electric circuit parts or equipment that haven't been de-energized. They must be capable of working safely on energized circuits and familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.

Overhead Lines



If work is performed near overhead lines, the lines must be de-energized before work is started. Protective measures are provided to prevent you from contacting lines directly with any part of your body or through conductive materials, tools, or equipment.

Vehicular and Mechanical Equipment

Any vehicle or mechanical equipment that have parts near energized overhead lines must be operated at a clearance of 10 feet.

Lighting

You can't enter spaces containing exposed energized parts, unless lighting is provided to perform the work safely. You can't reach blindly into areas that contain energized parts.

Confined Work Spaces

When you work in a confined or closed space like a manhole or vault that has exposed energized parts, you must use protective shields, protective barriers, or insulating materials to avoid contact with these parts. Doors and hinged panels must be secured to prevent swinging into you and causing contact with exposed energized parts.

Conductive Materials and Equipment

Conductive materials and equipment that are in contact with any part of your body has to be handled so it will prevent contact of exposed energized conductors or circuit parts.

Portable Ladders

Portable ladders have non-conductive side rails in case the ladder could contact exposed energized parts.

Conductive Apparel

Conductive articles of jewelry and clothing can't be worn in case they might contact exposed energized parts.

Housekeeping Duties

Where live parts could be an electrical contact hazard, you can't do housekeeping duties so close to the parts that there is a possibility of contact, unless insulating equipment is provided.

Electrically conductive cleaning materials can't be used near energized parts unless procedures are followed that will prevent electrical contact.

Use of Equipment

Portable Electric Equipment

This section applies to the use of cord- and plug-connected equipment, including flexible cord sets (extension cords).

Handling

Portable equipment is handled so it won't cause damage. Flexible electric cords connected to equipment can't be used for raising or lowering the equipment. Flexible cords can't be fastened with staples or hung so that they could damage the insulation.

Grounding-Type Equipment

A flexible cord used with grounding-type equipment must have an equipment-grounding conductor. Attachment plugs and receptacles can't be connected to prevent equipment grounding. Adapters that interrupt the grounding connection can't be used.

Your hands can't be wet when plugging and unplugging flexible cords and cord-and plug-connected equipment or you might get electrocuted.

Electric



Test

Power and Lighting Circuits

After a circuit is de-energized by a circuit protective device, the circuit can't be manually re-energized until you make sure that the equipment and circuit can be safely energized.

Instruments and Equipment

Only qualified people can perform testing work on electric circuits or equipment.

Test instruments and equipment and all leads, cables, power cords, probes, and connectors are inspected for defects and damage before the equipment is used. If a defect might expose you to injury, the damaged item must be removed from service, and no one can use it until it is repaired and tested.

Occasional Use of Flammable or Ignitable Materials

Where flammable materials are present only electric equipment capable of igniting them can't be used, unless measures are taken to prevent hazardous conditions from developing.

Safeguards for Personnel Protection

Use of Protective Equipment

Personnel Protective Equipment

Employees working in areas where there are potential electrical hazards are provided with, and must use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.

Employees must wear non-conductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts.

Employees must wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion.

General Protective Equipment and Tools

When working near exposed energized conductors or circuit parts, each employee uses insulated tools or handling equipment if the tools or handling equipment might make contact with conductors or parts.

Fuse handling equipment, insulated for the circuit, must be used to remove or install fuses when the fuse terminals are energized.

Ropes and hand lines used near exposed energized parts must be non-conductive.

Protective shields, protective barriers, or insulating materials must be used to protect each employee from shock, burns, or other electrically-related injuries while that employee is working near exposed energized parts which might be accidentally contacted or where dangerous electric heating or arcing might occur.

Alerting Techniques

The following alerting techniques must be used to warn and protect employees from hazards that could cause injury from electric shock, burns, or failure of electric equipment parts:

1. Safety signs and tags. Safety signs, symbols, or accident prevention tags must be used where necessary to warn employees about electrical hazards.
2. Barricades. Barricades must be used with safety signs to prevent employee access to work areas that have energized conductors or circuit parts that aren't insulated.

Summary

A detailed outline of Lesson 4 summarizes each area that you learned as follows:

A. Electrical

1. Electrical Equipment Design
2. Identification for Disconnecting Electrical Equipment and Circuits
3. 600 Volts or less
4. 600 Volts or more

B. Wiring Protection

1. Use and Identification of Grounded and Grounding Conductors
2. Equipment Connected by Cord and Plug
3. Non-Electrical Equipment

C. Wiring Methods, Components and Equipment for General Use

1. Temporary Wiring
2. Switches
3. Switchboards and Panelboards
4. Conductors for General Wiring
5. Flexible Cords and Cables
6. Equipment for General Use

D. Hazardous Locations

E. Electrical Safety Work Practices

F. Covered Work

1. Qualified Persons
2. Unqualified Persons

G. Training

H. Selection and Use of Work Practices

1. Working On or Near Exposed De-energized Parts

2. Lockout and Tagging
3. Working On or Near Exposed Energized Parts
4. Vehicular and Mechanical Equipment

I. Use of Equipment

1. Portable Electric Equipment
2. Electric Power and Lighting Circuits
3. Test Instruments and Equipment

J. Safeguards for Personnel Protection

1. Use of Protective Equipment
2. Alerting Techniques

Lesson 4 Test - Electrical

1. **Electrical equipment is designed to protect you from safety hazards that could cause death or serious physical harm. The safety of electrical equipment has the following considerations, except for which one?**
 - a) The use of the electrical equipment for a specific purpose and labeled for that identified purpose.
 - b) The protection for all parts from corrosion.
 - c) Electrical insulation.
 - d) Arcing effects.
2. **The grounded conductor is an energized circuit conductor that is connected to earth through the system ground. It is commonly referred to as:**
 - a) The root.
 - b) The neutral.
 - c) The ground fault current connector.
 - d) The negative.
3. **Flexible cords are allowed in what place?**
 - a) Ducts used for dust or flammable vapors.
 - b) Any duct used for ventilation of commercial cooking equipment.
 - c) Connection of portable lamps or appliances.
 - d) Where run through doorways or windows.
4. **Hazardous locations have a potential for explosion and fire because of all items below except which one?**
 - a) Flammable gasses, vapor or dusts.
 - b) Vaporized cleaning detergents.
 - c) The presence of easily ignitable fibers.
 - d) From processing chemicals and grains.

5. **Electrical safety work practices are for working near exposed parts of electrical equipment and the safe use of electrical equipment. These include all of the things below except for which one?**
- a) Using leather gloves for insulation against live parts.
 - b) Keeping a distance from exposed energized lines.
 - c) Avoiding the use of electric equipment when you or the equipment is wet.
 - d) Locking-out and tagging equipment that is de-energized for maintenance.
6. **Electrical safety-related work practices for qualified and unqualified employees include all of the following areas except for:**
- a) The installation of temporary wiring during construction.
 - b) Installation in mobile homes and recreational vehicles.
 - c) Installation in ships, watercraft, railway rolling stock, aircraft, or automotive vehicles.
 - d) The installation of communications equipment.
7. **Training is provided for employees who face a risk of electric shock. Employees in certain occupations face this risk and must be trained. Which occupation does not need to be trained?**
- a) Electricians.
 - b) Painters.
 - c) Security guards.
 - d) Welders.
8. **Safety-related work practices prevent electric shock or injuries from electrical contacts when work is done near equipment or circuits that can be energized. Which safety rule is false?**
- a) Live parts that you can be exposed to must be de-energized before you work on or near them.
 - b) Live parts that are less than 50 volts don't need to be de-energized if there won't be exposure to electrical burns or to explosion due to electric arcs.
 - c) You can work on electric circuit parts or equipment that haven't been de-energized if you are familiar with the proper use of insulating and shielding materials.
 - d) While you are exposed to contact with parts of electrical equipment or circuits that are de-energized, the circuits energizing the parts must be locked out or tagged.

9. For cord and plug-connected equipment, including extension cords, which statement is false:

- a) Flexible electric extension cords connected to equipment can be used for raising or lowering the equipment.
- b) Flexible cords can't be fastened with staples or hung so that they could damage the insulation.
- c) Attachment plugs, adapters and receptacles can't be connected to prevent equipment grounding.
- d) Where flammable materials are present only electric equipment capable of igniting them can't be used.

10. Employees working in areas where there are potential electrical hazards must use electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed. Which safety rule is false?

- a) Employees must wear non-conductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts.
- b) Employees must wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs, flashes or from flying objects from electrical explosions.
- c) Protective shields, protective barriers, or insulating materials must be used to protect each employee from shock or burns while working near exposed energized parts.
- d) Ropes and hand lines used near energized parts must be grounded to protect employees from hand and arm burns.

5. Hazard Communication

Introduction

There are over 32 million workers exposed to chemical hazards. There are also more than 575,000 existing chemicals and hundreds of new ones every year. This is a serious problem for workers and their employers.



Chemical exposure can cause serious health effects like heart problems, kidney and lung damage, sterility, cancer, burns, and rashes. Some chemicals can be safety hazards and cause fires, explosions and other serious accidents.

Because of these safety and health problems, and because many employers and employees know little about them, the Occupational Safety and Health Administration (OSHA) has a rule called "Hazard Communication." They want to

make sure that you know about work hazards and how to protect yourself to help reduce chemical illness and injuries.

Chemical manufacturers must provide hazard information to you and your employer with labels or containers and material safety data sheets (MSDS's). These sheets provide hazard information for you, to help you understand safety protection at work.

The Hazard Communication standard is different from other OSHA health rules because it covers all hazardous chemicals.

In general, it works like this:

Chemical Manufacturers/ Importers	Determine the hazards of each product
Chemical Manufacturers/ Importers/Distributors	Communicate the hazard information and associated measures downstream to customers through labels and MSDS's.
Employers	Identify and list hazardous chemicals in their workplaces. Obtain MSDS's and labels for each hazardous chemical. Develop and implement a written hazard communication program, including labels, MSDS's, and employee training, based on the list of chemicals, MSDS's and label information. Communicate hazard information to their employees through labels, MSDS's and formal training programs.

Purpose

Objectives

You will better understand the intent and purpose for a hazard communication program in your workplace. You will be able to look for hazardous chemicals and their Material Safety Data Sheets.

Outcomes

In Lesson 5 you will learn the principles and procedures used in hazard communication. This will include hazard evaluation, written hazard communication programs, labels and warnings. Special attention will be made to Material Safety Data Sheets, a list of hazardous chemicals, employee information and training.

Medical emergencies will be covered, including special requirements for trade secret chemicals and for non-emergencies.

The Hazard Communication Standard will be explained so that you can become familiar with the rules and identify the responsible staff members. This will include the hazardous chemicals identified as part of the Hazard Communication Program.

Special attention will be made to labels and warnings. You will be able to understand information contained on labels, in regulatory compliance and on Material Safety Data Sheets.

Finally, a Checklist for Compliance is provided so that you understand the basic safety requirements of hazard communications.

Quiz

1. Material safety data sheets are?
 - A) Protective sheets of plastic.
 - B) Fire-safe list of materials.
 - C) List of safety violations.
 - D) Data about hazardous chemicals.

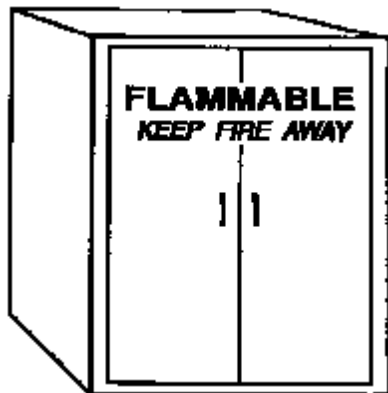
2. The content of trade secret chemicals are?
 - A) Never revealed.
 - B) Protected from theft.
 - C) Told to doctors.
 - D) Sealed in containers.

3. Exposed to hazardous chemicals means:
 - A) Books on chemicals.
 - B) Leaking chemicals.
 - C) Contact with chemicals.
 - D) Training on chemicals.

Hazard Communication

Hazard Evaluation

The quality of hazard communication depends on the accuracy of hazard assessment. Chemical manufacturers are required to review available scientific evidence concerning the hazards of the chemicals they produce, and to report the information that they find to their employees and to companies that distribute or use the products. Companies rely on these evaluations to establish the hazards of the chemicals they use.



Each chemical is evaluated for the potential to cause health effects and pose physical hazards like combustion or fire. Chemicals that are listed are considered hazardous:

- **Toxic and Hazardous Substances**
- **Chemical Substances and Physical Agents in the Environment**

Chemicals that have been evaluated and are a carcinogen must be reported.

Written

Hazard Communication Program

Your employer has a written hazard communication program that includes container labeling, collection and availability of material safety data sheets. It also contains a list of hazardous chemicals in each work area, how you handle hazards of non-routine tasks and the chemicals in unlabeled pipes. If there are multiple employers at work (for example, a construction site), these employers make sure that hazard information and protective measures are available to the other employers on-site.

The written program doesn't have to be complicated. Some employers rely on existing hazard communication programs to comply with the requirements. Each written program must be available to you.

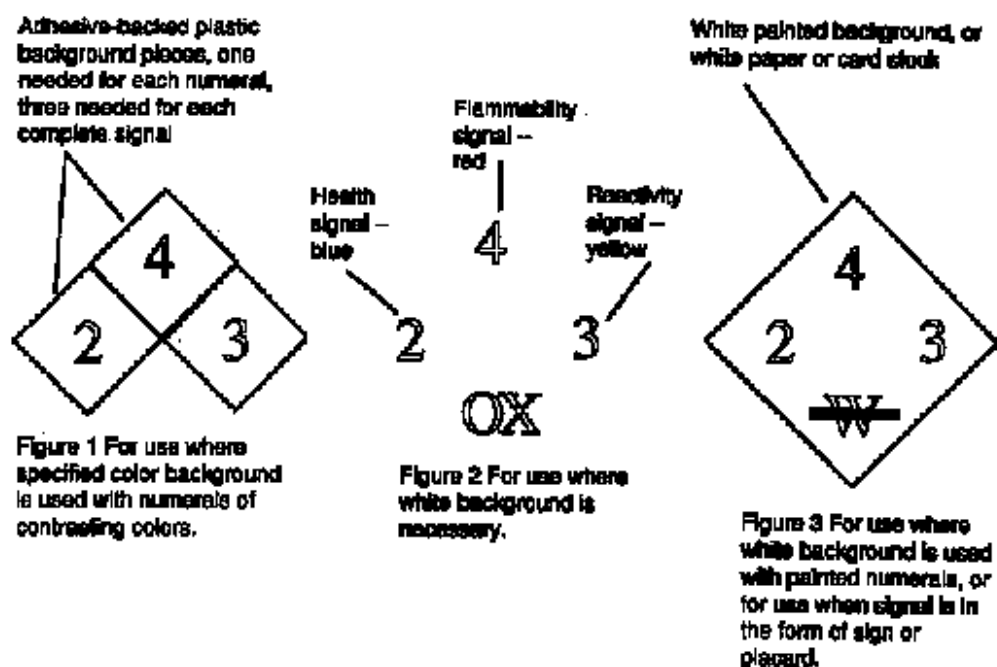
Labels and Warnings

Chemical manufacturers and distributors make sure that containers of hazardous chemicals are labeled, tagged or marked with the identity of the chemicals, hazard warnings, and the name and address of the manufacturer.

Each container is labeled, tagged or marked with the identity of hazardous chemicals that they contain and show hazard warnings for your protection. The hazard warnings can be any type of message, words, pictures, or symbols that show the hazards of the chemical(s) in the container.

Your company can also post signs that show the hazard information if there are a number of containers in a work area that have similar contents and hazards.

Alternate Arrangements For Display of NFPA 704 Hazard Identification System



Your company isn't required to label portable containers where hazardous chemicals are transferred from labeled containers.

Material Safety Data Sheets

Chemical manufacturers have an MSDS (Material Safety Data Sheet) for each hazardous chemical they produce and provide the MSDS with the first shipment of a hazardous chemical.

Each MSDS is in English and includes information regarding the specific chemical identity of the hazardous chemical involved and their common names. Information about the physical and chemical characteristics of the hazardous chemical; the known acute and chronic health effects and other health information; exposure limits; the chemical considerations as a carcinogen; precautionary measures; emergency and first-aid procedures; and the identification of the organization responsible for preparing the sheet.

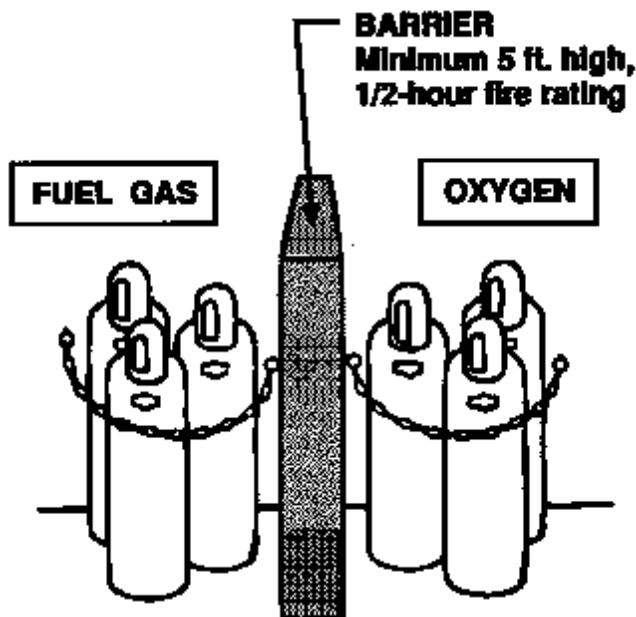
Copies of the MSDS for hazardous chemicals in a given work site are available to anyone in that area.

List of Hazardous Chemicals

Your company has lists of all hazardous chemicals at work. If there are hazardous chemicals used that don't have MSDS sheets, your company writes to the supplier or manufacturer to get the missing MSDS.

Employee Information and Training

Companies have training and information programs for employees exposed to hazardous chemicals in their work area. They provide training on initial job assignments and when a new hazard is brought into the work area.



Information

Hazardous materials information includes:

- The hazard communication standard and the requirements.
- The parts of the hazard communication program in your work.
- Operations in work areas where hazardous chemicals are present.
- Where your company keeps the written hazard evaluation procedures, communications program, lists of hazardous chemicals, and the required MSDS forms.

Training

Employee training has the following parts:

- How the hazard communications program is implemented, reading and interpreting information on labels and the MSDS, and how you can get and use hazard information.
- The hazards of the chemicals in the work area.
- Measures that you can take to protect yourself from the hazards.

- Procedures to provide protection such as engineering controls, work practices, and the use of personal protective equipment.
- Methods and observations, such as visual appearances or smell, that you can use to detect a hazardous chemical that you can be exposed to.

Medical Emergencies

Trade Secret Chemicals

For “trade secret” chemicals, the chemical manufacturer or your company can explain the specific chemical identity of a hazardous chemical to a doctor or nurse when the information is needed for proper emergency or first-aid treatment. The doctor or nurse has the responsibility to determine if a medical emergency exists.

Non-Emergencies

In non-emergency situations, chemical manufacturers or your company can explain specific “trade secret” chemical identity to health professionals providing medical or other occupational health services to exposed employees.

The request for information is in writing and describes the medical or occupational health need for the information in detail. The information is used to:

- Assess hazards of the chemicals that you are exposed to.
- Conduct or assess the workplace to determine your exposure levels.
- Conduct medical observation of exposed employees.
- Provide medical treatment to exposed employees.
- Select or assess personal protective equipment for exposed employees.
- Design or assess engineering controls and protective measures for exposed employees.
- Conduct studies to determine the health effects of exposure.

Hazard Communication Standard

The Hazard Communication Standard is based on a simple concept - that you have a need and a right to know the hazards and identities of the chemicals that you are exposed to when working. You also need to know what protective measures are available to prevent unfortunate effects from occurring.

When your company has information about the chemicals being used, they can take steps to reduce exposures, substitute less hazardous materials, and establish proper work

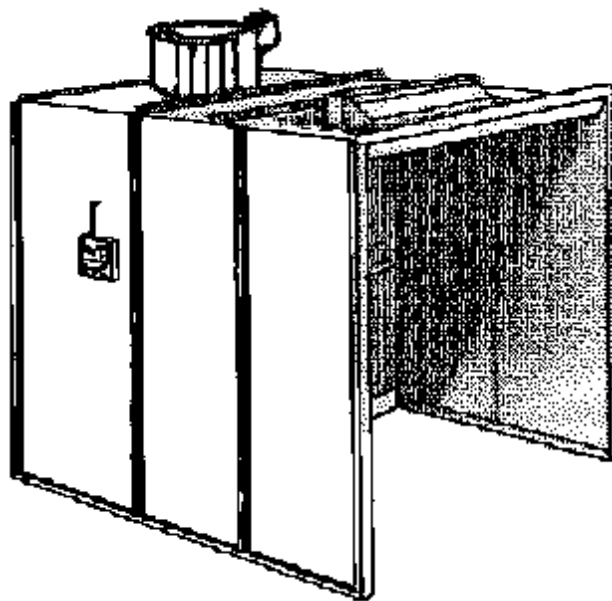
practices. These efforts help prevent work-related illnesses and injuries caused by chemicals.

Companies that simply use chemicals, rather than produce them, are not required to evaluate the hazards of chemicals. Hazard determination is the responsibility of the producers of the materials. Producers of chemicals are required to provide the hazard information to companies that purchase their products.

Companies that don't produce chemicals have a workplace program and communicate information to their workers. This lesson provides a general guide for companies to help them determine what's required under the rule. It provides an outline of the steps to follow to meet requirements.

Becoming Familiar with the Rule

The requirements show what companies have been doing for years. Companies might already be compliant with the provisions, and simply have to modify their existing programs. Many states have hazardous communication or "right-to-know" laws that companies must follow.



The HCS requires information to be prepared and communicated regarding all hazardous chemicals. The HCS covers both physical hazards (such as flammability), and health hazards (such as irritation, lung damage, and cancer). Most chemicals used at work have some hazard potential, and are covered by the rule.

Chemical manufacturers and distributors of hazardous chemicals provide labels and material safety data sheets to the companies where they ship chemicals. Every container of hazardous

chemicals you receive is labeled, tagged or marked with the required information. Your suppliers send you a material safety data sheet (MSDS) at the time of the first shipment of the chemical.

You can rely on the information received from your suppliers. You don't need to analyze the chemical or evaluate the hazards.

Companies that "use" hazardous chemicals have a program to make sure the information is provided to exposed employees. "Use" means to package, handle, react, or transfer.

There are two types of work operations where the rule is limited. These are laboratories and operations where the chemicals are only handled in sealed containers, like a warehouse. Companies that have these types of work operations only need labels on

containers as they are received; maintain material safety data sheets that are received, and give you access to them; and provide information and training for you. Companies don't have to have written hazard communication programs and lists of chemicals for these types of operations.

Identify Responsible Staff

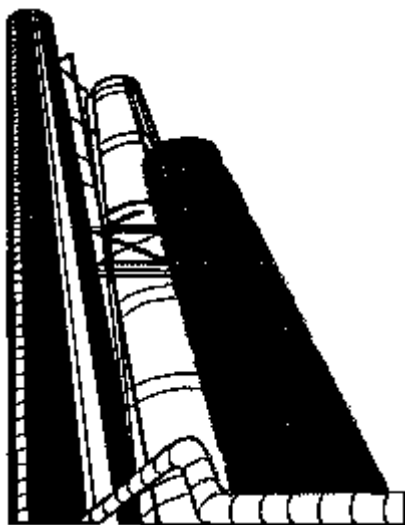
Hazard communication is a continuing program at work. Compliance with the HCS isn't a "one shot deal." It is necessary to assign responsibility for both the initial and ongoing activities that have to be taken to comply with the rule. In some cases, these activities can already be part of current job assignments. For example, site supervisors are frequently responsible for on-the-job training sessions.

For any safety and health program, success depends on commitment at every level of the organization. This is particularly true for hazard communication, where success requires a change in behavior. This occurs only if companies understand the program, and are committed to its success and if presenting the information motivates you.

Hazardous Chemicals

The standard requires a list of hazardous chemicals in the workplace as part of the written hazard communication program. The list serves as an inventory of everything where an MSDS must be maintained.

Sometimes you think of "chemicals" as being only liquids in containers. They can also be liquids, solids, gases, vapors, fumes and mists. The hazardous nature of the chemical and the potential for exposure determine whether a chemical is covered.



Look around. Identify chemicals in containers, including pipes, and think about chemicals generated in the work operations. For example, welding fumes, dusts, and exhaust fumes are all sources of chemical exposures. Read labels provided by the suppliers for hazard information. Make a list of all chemicals that are hazardous. For your own information and planning, you can also note on the list the location of the products at work, and an indication of the hazards found on the label.

Food, drugs and cosmetics that you bring to work for normal use are exempt; also rubbing alcohol in the first aid kit isn't covered.

Once you have compiled a complete list of the potentially hazardous chemicals at work, the next step is to determine if you have received material safety data sheets for all of them. Check files against the inventory you have just compiled. If any are missing, contact your supplier and request one. If you have MSDS's for chemicals that are not in your list, figure out why. Maybe you don't use the chemical anymore. Or maybe you missed it in your survey. Some suppliers do provide MSDS's for products that are not hazardous. These don't have to be maintained.

Companies shouldn't allow you to use any chemicals that don't have an MSDS. The MSDS provides information you need to make sure that protective measures are in place prior to exposure.

Hazard Communication Program

All workplaces where you are exposed to hazardous chemicals must have a written plan that describes how the standard will be implemented. The only work operations that don't have to comply with the written plan requirements are laboratories and work operations where you only handle chemicals in sealed containers.

The plan is intended to be a blueprint for implementation of the program.

Many trade associations and professional groups have sample programs and assistance materials for companies. These are very helpful to many companies when they are tailored to the particular industry involved.

Although general guidance can be helpful, remember that the written program has to reflect what you are doing at work. The written plan lists the chemicals present at the site, indicates who is to be responsible for the program, and indicates where written materials are available.

If OSHA inspects your company for compliance, the compliance officer will ask to see their written plan before inspection.

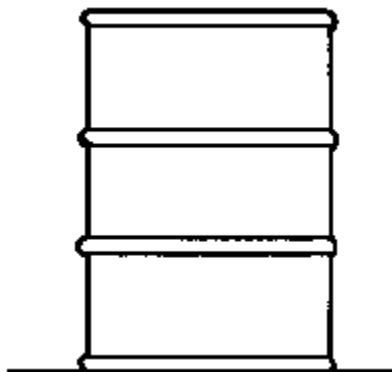
The following section lists the type of information a compliance officer looks for to decide whether the hazard communication program is proper.

Labels and Warnings

Containers of hazardous chemicals are labeled, tagged, or marked with the identity of the material. Distributors make sure that every container of hazardous chemicals they ship is labeled with information and the name and address of the producer. Companies that purchase chemicals rely on the labels provided by their suppliers. If the material is transferred from a labeled container to another container, the company labels the container unless it is a portable container.

Labels

The primary information on a label is an identity of the material and appropriate hazard warnings. The identity is any term that appears on the label, the MSDS and the list of chemicals. The identity used by the supplier is a common or trade name ("Black Magic Formula"), or a chemical name (trichloroethane). The hazard warning is a brief statement of hazardous effects of the chemical ("flammable," "causes lung damage"). Labels contain other information, such as precautionary measures ("do not use near open flame").



Compliance

The compliance officer looks for information to make sure that labeling is proper at your company:

- Designation of person(s) responsible for ensuring labeling of in-plant containers;
- Designation of person(s) responsible for ensuring labeling of any shipped containers;
- Description of labeling system(s) used;
- Description of written alternatives to labeling of in-plant containers (if used); and
- Procedures to review and update label information when necessary.
- Companies that are purchasing and using hazardous chemicals - rather than producing or distributing them - are concerned that every purchased container is labeled. If materials are transferred into other containers, the company makes sure that these are also labeled, unless they are portable containers. You can use the labels provided by your suppliers on the containers. These are text labels, and don't include rating or symbols that require special training. The most important thing to remember is that this is a continuing duty - all in-plant containers of hazardous chemicals must always be labeled. It is important to have someone responsible for making sure that the labels are on the containers in your facility, and that new materials are checked for labels before they are used.

Material Safety Data Sheets

Chemical manufacturers have a material safety data sheet for each hazardous chemical they produce. Distributors make sure that their customers are given a copy of these MSDS's. Companies have an MSDS for each hazardous chemical that they use. Companies rely on the information received from their suppliers.

have access to the MSDS's yourself. Simply being able to get the information over the phone is only allowed with mobile work sites, when you have to travel between workplaces during your shift. In this case, you have access to the MSDS's prior to leaving your work site, and when you return, so the telephone system is simply an emergency arrangement.

In order to make sure that you have a current MSDS for each chemical in the plant, and that you can have access, the compliance officer look for types of information in a written program:

- Designation of a person responsible for obtaining and maintaining the MSDS's;
- How sheets are maintained in the workplace, like notebooks in the work area or in a computer with terminal access, and how you can get access to them when you are in your work area during the work shift;
- Procedures to follow when the MSDS is not received at the time of the first shipment;
- For producers, procedures to update the MSDS when new and significant health information is found; and
- Description of alternatives to actual data sheets in the workplace, if used.

For companies using hazardous chemicals, the most important aspect of the written program in terms of MSDS's is to make sure that someone is responsible for obtaining and maintaining the MSDS's for every hazardous chemical in the workplace. The list of hazardous chemicals serves as an inventory. As new chemicals are purchased, the list is updated. Many companies include the name and address of the person designated in their company to receive MSDS's on their purchase orders.

Information and Training

Each employee who can be "exposed" to hazardous chemicals when working must be provided information and be trained prior to initial assignment to work with a hazardous chemical, and whenever the hazard changes. "Exposure" or "exposed," means "an employee is subject to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.) And includes potential (e.g., accidental or possible) exposure." Information and training can be done either by individual chemical or by categories by hazards (such as flammability or carcinogen). If there are only a few chemicals in the workplace, then you want to discuss each one individually. Where there are a large number of chemicals, or the chemicals change frequently, you will probably want to get trained based on the hazard categories (e.g., flammable liquids, corrosive materials, and carcinogens). You do have access to the substance-specific information on the labels and MSDS's.

Information and training are a critical part of the hazard communication program. Information regarding hazards and protective measures is provided with written labels and material safety data sheets. Through training, you learn to read and understand this

information, determine how it can be obtained and used in your own work, and understand the risks of exposure to the chemicals in your work as well as the ways to protect yourself. It isn't sufficient to just read material to you or simply hand you material to read. Your company wants you to ask questions. This will help you understand the information. You must always remember that the purpose of the HCS is to reduce the incidence of chemical source illness and injuries. This is accomplished by modifying behavior through understanding chemical hazards information and information about protective measures. The procedures your company has about the purchase, storage, and handling of chemicals improves and reduces the risks of you being exposed to chemical hazards. Your company's workers' comprehension may be increased, and proper work practices will be followed in your workplace.

In reviewing your company written plan about information and training, the following items need to be considered:

- Designation of a person responsible for conducting training;
- Format of the program to be used (audiovisuals, classroom instruction, etc.);
- Parts of the training program, and
- Procedure to train new employees at the time of their initial assignment to work with a hazardous chemical and to train employees when a new hazard is introduced into the workplace.

The written program provides details about the company plans to assess whether or not a good faith effort is being made to train employees. The most important aspects of training are to make sure that you are aware that you are exposed to hazardous chemicals, that you know how to read and use labels and material safety data sheets and that you are following the appropriate protective measures established by the company.

Other Requirements



Compliance officers ask the following questions in assessing the adequacy of the hazardous chemicals program:

Does a list of the hazardous chemicals exist in each work area or at a central location?

Are methods the employer will use to inform employees of the hazards of non-routine tasks outlined?

Are employees informed of the hazards associated with chemicals contained in unlabeled pipes in their work areas?

On multi-employer work sites, has the employer provided other employees with information about labeling systems and precautionary measures where the other employers have employees exposed to the initial employer's chemicals?

Is the written program made available to employees and their designated representatives?

If your program adequately addresses the means of communicating information to employees in your workplace, and provides answers to the basic questions outlined above, it will be found to be compliant with the rule.

Checklist for Compliance

The following checklist will help to make sure your company is compliant with the rule:

- ☐ Obtained a copy of the rule.
- ☐ Read and understood the requirements.
- ☐ Assigned responsibility for tasks.
- ☐ Prepared an inventory of chemicals.
- ☐ Ensured containers are labeled.
- ☐ Obtained MSDS for each chemical.
- ☐ Prepared written program.
- ☐ Made MSDS's available to workers.
- ☐ Conducted training of workers.
- ☐ Established procedures to maintain current program.
- ☐ Established procedures to evaluate effectiveness.

Summary

A detailed outline of Lesson 5 summarizes each area that you learned as follows:

A. Hazard Communication

1. Hazard Evaluation
2. Written Hazard Communication Program
3. Labels and Warnings

B. Material Safety Data Sheets

1. List of Hazardous Chemicals
2. Employee Information and Training

C. Medical Emergencies

1. Trade Secret Chemicals

2. Non-Emergencies

D. Hazard Communication Standard

1. Becoming Familiar with the Rule

2. Identify Responsible Staff

E. Hazardous Chemicals

F. Labels and Warnings

1. Labels

2. Compliance

3. Material Safety Data Sheets

G. Information and Training

H. Checklist for Compliance

Lesson 5 Test – Hazard Communication

1. **A written hazard communication program includes hazard information and protective measures for your safety. Which statement is false?**
 - a) A written hazard communication program includes container labeling.
 - b) Material safety data sheets are part of a written hazard communication program.
 - c) A list of hazardous chemicals is found in a written hazard communication program.
 - d) The written hazard communication program is very detailed and complicated.
2. **Chemical manufacturers provide a Material Safety Data Sheet for each hazardous chemical. What information is not found on an MSDS?**
 - a) Chemical identity of the hazardous and common name.
 - b) Emergency and first aid phone numbers for your company.
 - c) Physical and chemical characteristics.
 - d) Health effects and exposure limits.
3. **Companies have training and information programs for employees exposed to hazardous chemicals in their work area. This hazardous materials information includes everything below except for what?**
 - a) The hazard communication standard and the requirements.
 - b) Blank MSDS forms for you to identify hazardous chemicals in your work area.
 - c) The parts of the hazard communication program in your work.
 - d) Operations in work areas where hazardous chemicals are present.
4. **For “trade secret” chemicals in medical emergencies, which statement is true?**
 - a) The chemical manufacturer or your company can explain the specific chemical identity of a hazardous chemical to a doctor.
 - b) The doctor has the responsibility to determine the chemical equation used to make the chemical.
 - c) Following the MSDS, your company has permission from the chemical manufacturer to release “trade secret” information to health professionals.
 - d) The request for “trade secret” information is in writing and is used to conduct medical experiments with volunteer employees.

5. **The Hazard Communication Standard is based on a need and a right to know the hazards, identities chemicals that you are exposed to and what protective measures are available to prevent injury. Which statement below is false?**
- a) When your company has information about the chemicals being used, they can take steps to reduce exposures, substitute less hazardous materials, and establish proper work practices.
 - b) Companies that simply use chemicals, rather than produce them, are not required to provide the hazard information to employees.
 - c) The HCS requires information to be prepared and communicated regarding all hazardous chemicals and covers both physical and health hazards.
 - d) Chemical manufacturers and distributors of hazardous chemicals provide labels and material safety data sheets to the companies where they ship chemicals.
6. **Companies don't have to have written hazard communication programs and lists of chemicals for which type of operations?**
- a) Where companies maintain material safety data sheets that they receive and give to you.
 - b) Laboratories where the chemicals are only handled in sealed containers.
 - c) Where companies only need labels on containers as they are received.
 - d) In companies that provide information and training for you about hazardous chemicals.
7. **Your company is required to have a list of hazardous chemicals in the workplace as an inventory of everything where an MSDS must be maintained. Which statement is false?**
- a) Chemicals include liquids in containers, solids, gases, vapors, fumes and mists.
 - b) Welding fumes, dusts, and exhaust fumes are all sources of chemical exposures.
 - c) Rubbing alcohol in the first aid kit, drugs and cosmetics that you bring to work are covered.
 - d) Companies shouldn't allow you to use any chemicals that don't have an MSDS.
8. **Containers of hazardous chemicals are labeled, tagged, or marked with the identity of the material. Which statement below is false?**
- a) Distributors make sure that every container of hazardous chemicals they ship is labeled with information and the name and address of the producer.
 - b) Companies that purchase chemicals rely on the labels provided by their suppliers.
 - c) If the material is transferred from a labeled container to another container, you remove the label from the container and place it on the portable container.
 - d) The primary information on a label is an identity of the material and appropriate hazard warnings.

9. Each employee who can be "exposed" to hazardous chemicals when working must be provided information and be trained prior to initial assignment to work with a hazardous chemical. Which statement below is the correct definition of "exposed"?
- a) An employee that moves a hazardous chemical through any route of entry in the workplace.
 - b) An employee that prepares a hazardous materials and chemical list for the written hazardous communication program.
 - c) An employee that has access to the substance-specific information on the labels and MSDS's of hazardous chemicals such as flammable liquids, corrosive materials, and carcinogens.
 - d) An employee that is subject to a hazardous chemical in the course of employment through any route of entry including inhalation, ingestion, skin contact or absorption.
10. The Checklist for Compliance does not include which item?
- a) Prepared an inventory of chemicals used.
 - b) Notified manufacturer of chemicals used.
 - c) Ensured containers are labeled.
 - d) Made MSDS's available to workers.

6. Personal Protective Equipment

Introduction

Hard hats, goggles, face shields, steel-toed shoes, respirators, aprons, gloves, and full body suits! What do all these items have in common? They are all forms of personal protective equipment (PPE).



Personal protective equipment is not a substitute for safety, work practices, or supervision. Personal protective equipment provides you with a safe and healthy workplace. Personal protective equipment includes all clothing and other work accessories designed to create protection against hazards. The basic element of a company program for PPE includes standard operating procedures for employees, training on the protective limitations of PPE, and on proper use and maintenance.

Using personal protective equipment means that you have hazard awareness and training. The equipment does not eliminate the hazard. If the equipment fails, you are exposure to safety hazards. To reduce the possibility of failure, equipment is properly fitted and maintained in a clean and usable condition.

Selection of the proper personal protective equipment for your job is important. You and your company must understand the equipment's purpose and its limitations. The equipment is not to be altered or removed, even if you think it is uncomfortable. In fact, sometimes equipment can be uncomfortable simply because it does not fit properly.

Purpose

Lesson 6 is all about personal protective equipment. These include the equipment that you are asked to wear while you are doing your assignments.

Objectives

In this lesson, you learn how to protect your eyes and face. It includes protection for breathing contaminated air, safety for your head and feet, hands and hearing.

Outcomes

Lesson 6 describes the personal protective equipment that you use to keep you safe. It provides special information about employee-owned equipment, hazard assessment and equipment selection.

Eye and face protection will include filter lenses, their selection, inspection and maintenance. Respiratory protection such as air-purifying devices, atmosphere or air-supplying devices, combination air-purifying and atmosphere-supplying devices are covered to protect the air that you breath.

Your head, hands, ears and feet are important. That's why you will learn about protective equipment, selection, fit, inspection and maintenance. Hearing protection includes information about earplugs and earmuffs. There is also information about the care and use of electrical protective devices.

Quiz

1. PPE means?

- A) Prior protection education.
- B) Personal protective equipment.
- C) Preparing for proper escape.
- D) Personnel policy on equipment.

2. You wear something on your head to protect from?

- A) Heat.
- B) Acids.
- C) Rain.
- D) Objects.

3. PPE includes:

- A) Head bands.
- B) Tennis shoes.
- C) Hard hats.
- D) Ladders.

Personal Protective Equipment - General Requirements

Your company makes sure that personal protective equipment is "provided, used, and maintained in a sanitary and reliable condition wherever it is necessary..." to prevent injury. This includes protection of any part of your body from hazards from absorption, inhalation or physical contact.

For example, many hazards can threaten the upper body: heat, splashes from hot metal and liquids, impacts, cuts, acids, and radiation. Many kinds of protective clothing are available: vests, jackets, aprons, coveralls, and full body suits.

Two natural fibers, wool and treated cotton, are fire-resistant, comfortable and adjust well to a variety of workplace temperatures.

Duck, a closely woven cotton fabric, is good for light-duty protective clothing. It can protect you from cuts and bruises on jobs where you handle heavy, sharp, or rough material.

Heat-resistant material, such as leather, is used in protective clothing to protect you against dry heat and flame. Rubber and rubberized fabrics, neoprene, and plastics give you protection against some acids and chemicals.

It is important that you look at the manufacturer's guidelines for the effectiveness of specific materials against specific chemicals.



Disposable suits made out of plastic or synthetic material are important for your protection from dusty materials or materials that can splash. If the substance is extremely toxic, a completely closed chemical suit might be necessary. The clothing should be inspected to make sure that it fits for your protection.

Employee-Owned Equipment

When you provide your own equipment, your supervisor must check the adequacy, maintenance and sanitation of the equipment.

All personal protective equipment must be safe and made for the work that it is to be used with.

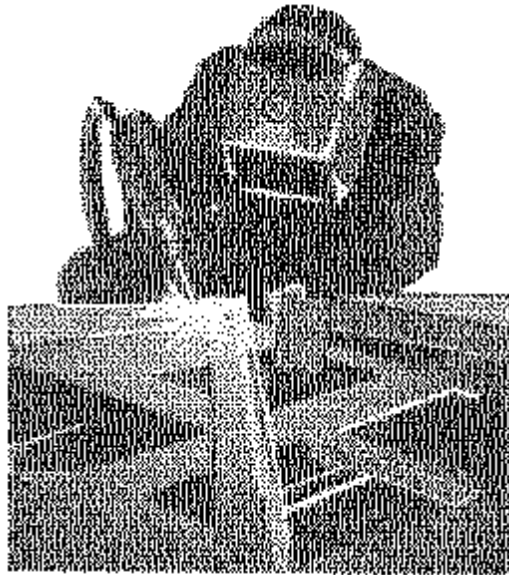
Hazard Assessment and Equipment Selection

Your employer is required to review the workplace for hazards that need personal protective equipment. If hazards are found, employers select and have you use properly fitted PPE for protection from the hazards.

Before doing work that uses personal protective equipment, you must be trained to know when personal protective equipment is necessary; what type is necessary; how it is worn; and what its limitations are, as well as know its proper care, maintenance, useful life, and disposal. Defective or damaged personal protective equipment must not be used.

Eye and Face Protection

Eye and face protective equipment is provided to protect you from injury to your eyes or face from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors and light radiation. This equipment also applies to supervisors and to visitors while they are in hazardous areas. Protectors meet the following requirements.



- They provide protection from the hazard;
- Are comfortable when you wear them;
- Fit snugly without interfering with your movement or vision;
- Are durable;
- Are capable of being disinfected;
- Are easily cleaned and repaired.

Every protector is marked to identify the manufacturer.

You use equipment with filter lenses that have a shade number for work being performed for protection from light radiation. The following is a listing of shade numbers for some kinds of work.

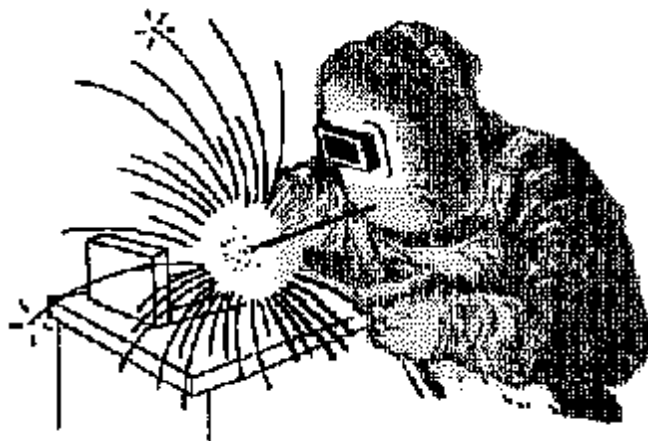
Filter Lenses for Protection Against Radiant Energy			
Operations	Electrode Size (inches diameter)	Arc Current (Amperes)	Minimum Protective Shade
Shielded metal arc welding	Less than 3/32	Less than 60	7
	3/32 - 5/32	60 - 160	8
	5/32 - 8/32	160 - 250	10
	More than 8/32	250 - 550	11
Gas metal arc welding and flux cored arc welding		Less than 60	7
		60 - 160	10
		160 - 250	10
		250 - 500	10
Gas Tungsten arc welding		Less than 50	8
		50 - 150	8
		150 - 500	10

Air carbon Arc cutting	(light) (heavy)	Less than 500 500 - 1000	10 11
Plasma arc welding		Less than 20 20 - 100 100 - 400	6 8 10
Plasma arc cutting	(light) (heavy)	Less than 300 300 - 400	8 9
Torch brazing		-	3
Torch soldering		-	2
Carbon arc welding		-	14

Plate Thickness			
	inches	mm	
Gas Welding: Light Medium Heavy	Less than 1/8	Less than 3.2	4
	1/8 - 1/2	3.2 - 12.7	5
	More than 1/2	More than 12.7	6
Oxygen cutting: Light Medium Heavy	Less than 1	Less than 25	3
	1 - 6	25 - 150	4
	More than 6	More than 150	5

When you are welding, you start with a shade that is too dark to see the weld zone. Then go to a lighter shade that gives you a sufficient view of the weld zone without going below the minimum. If you are using fuel, gas, welding or cutting where the torch produces a high yellow light, you use a filter lens that absorbs the yellow or sodium line in the visible light.

These values apply where the actual arc is clearly seen. Lighter filters may be used when the arc is hidden by the work piece.



OSHA and the National Society to Prevent Blindness recommend that emergency eyewashes be put in all hazardous locations. First-aid instructions are posted close to potential danger spots since any delay to immediate aid or an early mistake in dealing with an eye injury can result in permanent damage.

Selection

Each eye, face, or face-and-eye protector is designed for a particular hazard. In selecting the protector, consideration is given to the kind of hazard. Where a choice of protectors is given, your comfort can be a deciding factor.

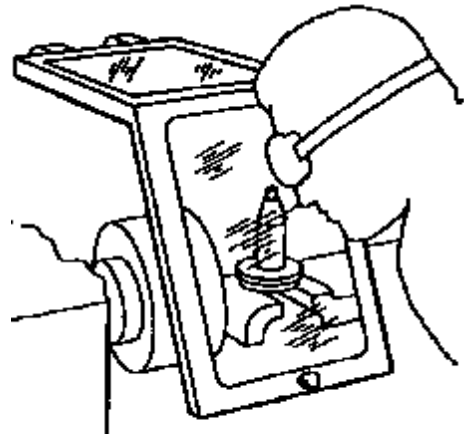
If you are required to wear eye protection, you must wear a face shield, goggles, or glasses like one of the following:

- glasses with protective lenses that provide optical correction;
- Goggles worn over corrective glasses without disturbing the adjustment of the glasses; or
- Goggles that have corrective lenses mounted behind the protective lenses.

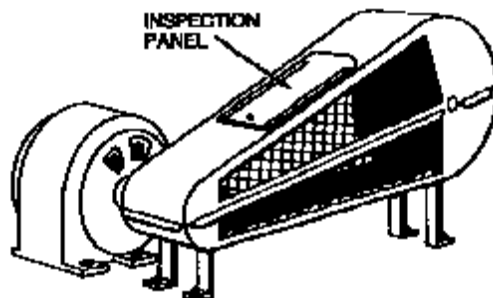
Goggles come in a number of different styles: eyecups, flexible or cushioned goggles, plastic eye shield goggles, and foundry goggles. Goggles are manufactured in several styles for specific uses like protecting against dust and splashing, in chipper welders and cutters.

Safety glasses require special frames. Combinations of normal street wear frames with safety lenses are not permitted.

Many hard hats and helmets are designed with face and eye protective equipment.



Inspection and Maintenance



The lenses of eye protectors must be kept clean. Continuously looking through dirty lenses causes you to strain your eyes, but that isn't an excuse for not wearing your eye protectors. You must inspect and clean your eye protectors daily with soap and hot water, or with a cleaning solution and tissue.

Pitted lenses, like dirty lenses, reduce vision. Deep scratches in lenses break easily. They should be replaced.

Slack, worn-out, sweat-soaked, or twisted headbands don't hold your eye protectors in position.

Goggles should be kept in a case when they are not used. Glasses should be given the same care as your own glasses, since the frames, nose pads, and temples can be damaged by rough usage.

Personal protective equipment that has been used in the past by someone else must be disinfected before you use the equipment.

When you are assigned protective equipment for extended periods, you should clean and disinfect the equipment regularly.

The most effective way to disinfect eye-protective equipment is to disassemble the goggles or glasses and clean all parts with soap and warm water. You rinse off all soap, and replace defective parts with new ones. You can swab and immerse all parts for 10 minutes in a solution of germicidal deodorant fungicide. Then you remove the parts from the solution and suspend them in a clean place for air drying at room temperature or with heated air. Don't rinse after removing the parts from the solution because this will remove the germicidal residue that keeps its effectiveness after drying.

The dry parts or items should be put in a clean, dust-proof container, such as a box, bag, or plastic envelope, to protect them until the next time you use them.

Respiratory Protection

Respiratory protective devices protect your health. They fall into three classes: air purifying; atmosphere or air supplying; and combination air purifying and supplying.

Air-



Purifying Devices

The air-purifying device cleans the contaminated air. Chemicals are used to remove specific gases and vapors and mechanical filters remove particulate matter. This type of respirator is limited in its use to areas where the air contaminant level is within the concentration limits of the device. These devices don't protect you against oxygen deficiency.

"Oxygen deficiency" means that there is little oxygen supplying respiratory protection. It exists in air where the percentage of oxygen is less than 19.5 percent.

The various types of air-purifying devices include mechanical-filter cartridge; chemical-cartridge, combination mechanical-filter/chemical-cartridge; gas masks; and powered air-purifying respirators.

Mechanical-filter respirators give you respiratory protection against airborne particulate matter, including dusts, mists, metal fumes and smokes, but don't provide protection against gases or vapors.

Chemical-cartridge respirators give you protection against certain gases and vapors by using various chemical filters to purify the inhaled air. They are different than mechanical-

filter respirators. They use cartridges containing chemicals to remove harmful gases and vapors.

Combination mechanical-filter/chemical-cartridge use dust, mist, or fume filters with a chemical cartridge for dual or multiple exposures.

Gas masks give you respiratory protection against certain gases, vapors, and particulate matter. Gas masks are designed to remove specific contaminants from the air. It is essential that their use be restricted to air that contains sufficient oxygen to support life. Gas masks can be used for escape only from air that is immediately dangerous to life or health, never for entry into that air.



Canisters for gas masks are color-coded according to the contaminant that they protect against.

Power air-purifying respirators protect against particulate, gases and vapors, or particulate and gases and vapors. The air-purifying element can be a filter, chemical cartridge, combination filter and chemical cartridge, or canister. The powered air-purifying respirator uses a power source like a battery pack to operate a blower that passes air across the air-cleaning element to supply purified air to the respirator. The advantage of the powered air-purifying respirator is that it usually supplies air at positive pressure so that any leakage is outward from your facemask. However, it is possible at high work rates to create a negative pressure in the facemask, increasing facemask leakage.

Atmosphere- or Air-Supplying Devices

Atmosphere- or air-supplying devices provide you with good air, different than the outside air. Atmosphere-supplying respirators fall into three groups: supplied-air respirators, self-contained breathing apparatus (SCBA), and combination-SCBA and supplied-air respirators.

Supplied-air respirators give you breathing air through a supply hose connected to your facemask. The air is free of contaminants and is from a source located in the clean air.

There are three types of supplied-air respirators: Type A, Type B and Type C. Type A supplied-air respirators are also known as hose masks with a blower. Air is supplied through a large diameter hose with a motor-driven or hand-operated blower. Type B supplied-air respirators are hose masks without a blower. You breathe air through the hose. Type C supplied-air respirators are called air-line respirators.

There are three basic classes of air-line respirators - continuous-flow, demand-flow, and pressure-demand flow.

Continuous flow. A continuous-flow unit has a regulated amount of air fed to the facemask and is used where



there is an ample supply like from an air compressor.

Demand flow. These air-line respirators deliver air flow only during inhalation. These respirators are used when the air supply is restricted to high-pressure compressed air cylinders. A suitable pressure regulator is required to make sure that the air is reduced to the proper pressure for breathing.

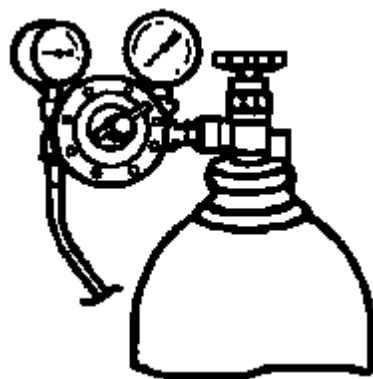
Pressure-demand flow. For those conditions where the possible inward leakage is unacceptable and where there isn't the high air consumption of the continuous-flow units, a pressure-demand air-line respirator can be the best choice. It provides a positive pressure during both inhalation and exhalation.

Types A, B, and C are approved for abrasive blasting and designated AE, BE, and CE. These respirators are equipped with additional devices designed to protect your head and neck against impact and abrasion from abrasive material and with shields to protect the windows of facemasks, hoods, and helmets.

Self-contained breathing devices provide complete respiratory protection against toxic gases and an oxygen deficiency. You are independent of the surrounding air because you are breathing with a system that is portable and admits no outside air. The oxygen or air supply of the device takes care of respiratory requirements.

There are two types of self-contained breathing devices: closed circuit and open-circuit. In the closed-circuit device, you breathe the exhaled air after the carbon dioxide has been removed and oxygen concentration is restored from sources made out of: compressed oxygen; or chemical oxygen or liquid-oxygen. In the open-circuit device, exhaling is vented to the atmosphere and you don't breathe it again. There are two types of open-circuit SCBA's: demand and pressure-demand.

Combination-SCBA and supplied-air respirators are air-line respirators with an auxiliary self-contained air supply. An auxiliary SCBA is an independent air supply that allows you to evacuate an area or enter the area for a very short period of time where a connection to an outside air supply can be made. The auxiliary air supply can be switched to in the event the primary air supply fails to operate. This allows you to escape from the contaminated air. Combination air-line respirators with auxiliary SCBA are designed to operate in three modes: continuous-flow, demand-flow, and pressure-demand flow.



Combination Air-Purifying and Atmosphere-Supplying Devices

A device that is a combination of an air-line respirator with an auxiliary air-purifying attachment provides protection in the event the air supply fails. These respirators are available in either continuous-flow or pressure-demand flow and are most often used with a high-efficiency filter. Use in the filtering mode is allowed for escape only. Because of the positive-pressure and escape provisions, these respirators have been recommended for asbestos work.

The following list is a summary of the classification of respiratory protective devices:

I. Air-Purifying Devices

- A. Mechanical-filter cartridge
- B. Chemical-cartridge
- C. Combination mechanical-filter/chemical cartridge
- D. Gas masks
- E. Powered air-purifying

II. Atmosphere- or Air-Supplying Devices

- A. Supplied-air
 - 1. Type A and AE
 - 2. Type B and BE
 - 3. Type C and CE (Airline)
 - a. Continuous-flow
 - b. Demand-flow
 - c. Pressure-demand flow
- B. Self-contained breathing apparatus (SCBA)
 - 1. Closed-circuit
 - 2. Open-circuit
 - a. Demand
 - b. Pressure-demand
- C. Combination-SCBA and supplied air
 - 1. Continuous-flow
 - 2. Demand-flow
 - 3. Pressure-demand flow

III. Combination Air-Purifying and Atmosphere Supplying Devices

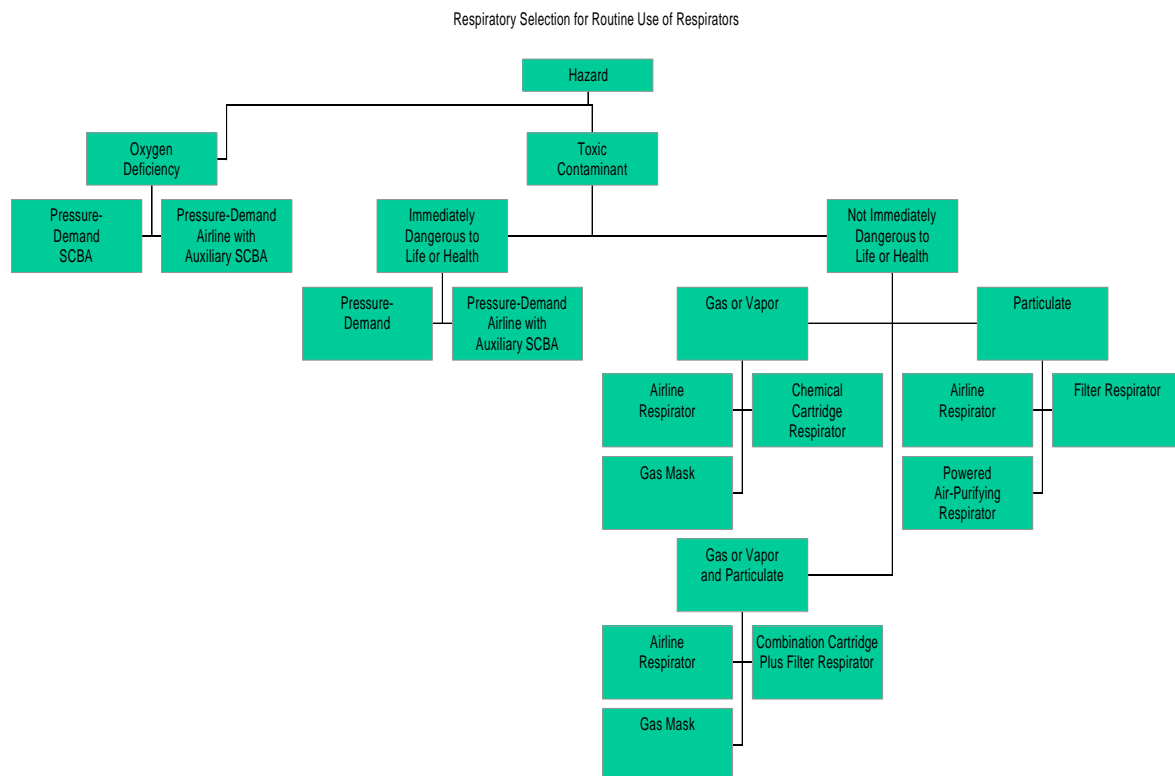
- A. Continuous-flow
- B. Pressure-demand flow

Proper Selection

Respirators are selected on the basis of hazards that you can be exposed to. A qualified individual specifies the respirator type in work procedures.

In selecting the correct respirator, many factors must be taken into consideration, for example, the nature of the hazard, location of the hazardous area, your health, work activity, and respirator characteristics, capabilities, and limitations.

In order to make these decisions; the hazard is identified to make sure that an overexposure does not occur. If oxygen deficiency isn't an issue, then the contaminant and concentration is determined. The following diagram gives an outline for the selection process.



Training and Fitting

You must be instructed and trained in the selection, use and maintenance of respirators. Every respirator user must receive fitting instructions including demonstrations and practice in how the respirator should be worn, how to adjust it, and how to determine if it fits properly.

Cleaning and Disinfecting

Respirators must be regularly cleaned and disinfected. Those issued for use by one person should be cleaned after each day's use or more often if necessary.

Storage

Respirators are "stored in a convenient, clean, and sanitary location." The purpose of good respirator storage is to make sure that the respirator will function properly when used. Care must be taken to ensure that respirators are stored in this way to protect against dust, harmful chemicals, sunlight, excessive heat or cold, and moisture.

Inspection and Maintenance

Respirators are inspected during cleaning after use. Worn or deteriorated parts must be replaced. Respirators for emergency use must be thoroughly inspected at least once a month and after each use.

Work Area Surveillance

You should observe your work area for conditions and degrees of exposure or stress. This should include identification of a contaminant, nature of the hazard, and concentration at the breathing zone.

Inspection and Evaluation

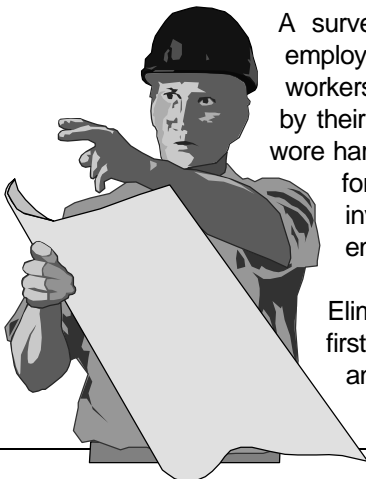
Inspection and evaluation determines the effectiveness of respirators. Many factors affect your acceptance of respirators, including comfort, ability to breathe without effort, adequate visibility under all conditions, provisions for wearing prescription glasses, ability to communicate, ability to perform all tasks without interference, and confidence in the facemask fit.

Medical Examinations

You should not be assigned to any task requiring the use of respirators unless you are physically able to perform the work and use the equipment. A physician must determine the health and physical conditions for your ability to work while wearing a respirator. Your medical status should be reviewed periodically.

Head Protection

Prevention of head injuries is an important factor to your safety. Most workers who suffer impact injuries to the head were not wearing head protection. The majority of workers are injured while performing their normal jobs at their regular work sites.



A survey showed that in most instances where head injuries occurred, employers hadn't required their employees to wear head protection. Of those workers wearing hard hats, all but 5 percent indicated that they were required by their employers to wear them. It was found that a majority of those who wore hard hats most of the time at work believed that hard hats were practical for their jobs. According to the report, in almost half of the accidents involving head injuries, employees knew of no action taken by employers to prevent such injuries from recurring.

Elimination or control of a hazard leading to an accident should be given first consideration, but many accidents causing head injuries are difficult to anticipate and control. Where these conditions exist, head protection

must be provided to eliminate injury.

Head injuries are caused by falling or flying objects, or by bumping the head against a fixed object. Head protection, in the form of protective hats, does two things - resists penetration and absorbs the shock of a blow. This is accomplished by making the shell of the hat of a material hard enough to resist the blow, and by utilizing a shock-absorbing lining made of a headband and crown straps to keep the shell away from your skull. Protective hats also are used to protect against electrical shock.

Selection

Each type and class of head protectors provides protection against specific hazardous conditions. An understanding of these conditions will help you in selecting the right protection for the particular situation.

Head protection is made in the following types and classes:

Type 1 - helmets with full brim, not less than 1 and ¼ inches wide;
and

Type 2 - helmets that don't have a brim and a peak extending
forward from the crown.

For industrial purposes, three classes are recognized:

Class A - general service, limited voltage protection

Class B - utility service, high-voltage helmets; and

Class C - special service, no voltage protection.

For firefighters, head protection must consist of a protective head device with earflaps and a chinstrap.

Helmets under Class A are intended for protection against hazards. They are used in mining, construction, shipbuilding, tunneling, lumbering, and manufacturing.

Class B, utility service helmets protect your head from impact and penetration by falling or flying objects and from high-voltage shock and burn. Electrical workers use them.

The safety helmets in Class C are designed for lightweight comfort and impact protection. This class is usually manufactured from aluminum and offers no electrical protection. Class C helmets are used in some construction and manufacturing occupations, oil fields, refineries, and chemical plants where there is no danger from electrical hazards or corrosion. They also are used where there is a possibility of bumping the head against a fixed object.

Materials used in helmets are water-resistant and slow burning. Each helmet consists of a shell and suspension. Ventilation is provided by a space between the headband and the shell.

You should be able to identify the type of helmet by looking inside the shell for the manufacturer, ANSI designation and class. For example:

Manufacturer's Name

ANSI Z89.1-1969 (or later year)

Class A

Fit

Headbands are adjustable in 1/8-size increments. When the headband is adjusted to the right size, it provides sufficient clearance between the shell and the headband. The removable or replaceable type sweatband should cover at least the forehead portion of the headband. The shell is one-piece, seamless and designed to resist the impact of a blow from falling material. The internal cradle of the headband and sweatband forms the suspension. Any part that contacts your head must not be irritating to normal skin.

Inspection and Maintenance

Some paints and thinners can damage the shell and reduce protection by physically weakening it or neutralize electrical resistance.

A common method of cleaning shells is dipping them in hot water that has a good detergent for at least a minute. Shells should be scrubbed and rinsed in clear hot water. After rinsing, the shell should be carefully inspected for any signs of damage.

All components, shells, suspensions, headbands, sweatbands, and any accessories should be visually inspected daily for signs of dents, cracks, penetration, or any other damage that might reduce the degree of safety provided.

You are cautioned that if unusual conditions occur, like higher or lower extreme temperatures or if there are signs of abuse or mutilation of the helmet or any component, the margin of safety can be reduced. If damage is suspected, helmets should be replaced or representative samples tested.

Helmets shouldn't be stored or carried in the rear-window of an automobile, since sunlight and heat can affect the degree of protection.

Foot Protection

Most workers that get foot injuries don't wear protective footwear. In addition, most of their employers didn't require them to wear safety shoes. Most workers are injured while doing their normal job at their work place.

For protection of your feet and legs from falling or rolling objects, sharp objects, molten metal, hot surfaces, and wet slippery surfaces, you should use appropriate foot guards, safety shoes, boots and leggings. Leggings protect your lower legs and feet from molten metal or welding sparks. Safety snaps let them be removed quickly.

Aluminum alloy, fiberglass, or galvanized steel foot guards are worn over usual work shoes. They can, however, catch on something and cause you to trip. Heat-resistant soled



shoes protect you from hot surfaces found in roofing, paving, and hot metal industries.

Safety shoes should be sturdy and have impact-resistant toes. In some shoes, metal insoles can protect you from puncture wounds. Other protection, like metatarsal guards, is in some types of footwear. Safety shoes come in a variety of styles and materials, like leather and rubber boots and oxfords.

Electrical Protective Devices

Insulating blankets, matting, covers, line hose, gloves, and sleeves made of rubber must meet requirements for the manufacture, including their marking, electrical properties, workmanship and finish.

Care and Use

Electrical protective equipment must be maintained in a safe, reliable condition.

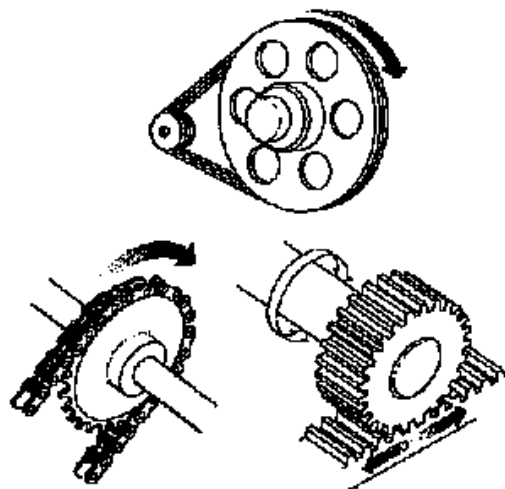
Specific requirements for their care and use are given by each manufacturer for insulating blankets, covers, and line hose, gloves and sleeves made of rubber.

Hand Protection

Companies select and require you to use hand protection when your hands are exposed to hazards like skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes.

Selection

There is a wide assortment of gloves, hand pads, sleeves, and wrist protectors for your protection against various hazardous situations.



Companies determine what hand protection you need. Your work activities are observed to determine the degree of dexterity, the duration, frequency, and degree of exposure to hazards and the physical stresses that will be applied.

Also, it is important for you to know the performance characteristics of gloves according to the specific hazard like the exposure to chemicals, heat, or flames.

Before purchasing gloves, your employer should request documentation from the manufacturer that the gloves meet

the appropriate test standards for the hazards. For example, for protection against chemical hazards, the toxic properties of the chemicals must be determined - particularly, the ability of the chemicals to pass through the skin and cause effects.

The protective device is selected to fit the job. For example, some gloves are designed to protect you against specific chemical hazards. You may need to use gloves - such as with wire mesh, leather, and canvas - to provide insulation from burns and cuts.

Hearing Protection

Exposure to high noise levels can cause hearing loss or impairment. It can create physical and psychological stress. There is no cure for noise-induced hearing loss, so your prevention of excessive noise exposure is the only way to avoid hearing damage. Specially designed protection is required, depending on the type of noise that you might be in contact with.

Earplugs

Waxed cotton, foam, or fiberglass wool earplugs are self-forming. When properly inserted, they work as well as most molded earplugs that are fitted by a professional.

Some earplugs are disposable, used one time and then thrown away. The non-disposable ones should be cleaned after each use for proper protection. Plain cotton doesn't work as protection from hazardous noise.

Earmuffs

Earmuffs need to make a perfect seal around the ear to be effective. Glasses, long sideburns, long hair, and facial movements, such as chewing, can reduce your protection. Special equipment is available for use with glasses or beards.

For very noisy situations, earplugs are worn in addition to earmuffs. When they are used together, earplugs and earmuffs change sounds. All sounds are reduced including your own voice, but other voices or warning devices are easier to hear.



Conclusion

Supervisors recognize hazards and are responsible for their employees' use of personal protective equipment. The safety program for new employees is necessary during your orientation program.

Combining the correct personal protective equipment with a good training program gives you extra safety where other controls are inadequate or impossible.

Personal protective equipment is effective only if the equipment is selected based on its intended use, you are trained in its use, and the equipment is properly tested, maintained and worn.

Summary

A detailed outline of Lesson 6 summarizes each area that you learned as follows:

A. Personal Protective Equipment – General Requirements

1. Employee-Owned Equipment
2. Hazard Assessment and Equipment Selection

B. Eye and Face Protection

1. Filter Lenses
2. Selection
3. Inspection and Maintenance

C. Respiratory Protection

1. Air-Purifying Devices
2. Atmosphere or Air-Supplying Devices
3. Combination Air-Purifying and Atmosphere-Supplying Devices

D. Head Protection

1. Selection
2. Fit
3. Inspection and Maintenance

E. Foot Protection

F. Electrical Protective Devices

G. Hand Protection

H. Hearing Protection

1. Earplugs
2. Earmuffs

Lesson 6 Test – Personal Protective Equipment

1. **When you bring your own personal protective equipment to work:**
 - a) You need prior written approval from the company.
 - b) You must wash the equipment in approved detergents before using.
 - c) Your supervisor must check the adequacy and sanitation of the equipment.
 - d) You are allowed to share your equipment with the other employees.
2. **Personal protective equipment provides you with a safe and healthy workplace against hazards. Which items below are not PPE (personal protective equipment)?**
 - a) Hard hats and respirators.
 - b) Head bands, personal glasses and tennis shoes.
 - c) Aprons, gloves, coveralls and full body suits.
 - d) Goggles, face shields and steel-toed shoes.
3. **Eye and face protective equipment is provided to protect you from injury to your eyes or face from all items below except for which one?**
 - a) Flying particles and light radiation.
 - b) Sharp metal edges and scratches.
 - c) Molten metal and liquid chemicals.
 - d) Acids, caustic liquids, gases and vapors.
4. **The lenses of eye protectors must be inspected and maintained. Which statement below is false?**
 - a) Slack, worn-out, sweat-soaked, or twisted headbands don't hold your eye protectors in position.
 - b) Pitted lenses reduce vision. Deep scratches in lenses break easily.
 - c) Continuously looking through dirty lenses can strain your eyes.
 - d) You must clean your eye protectors monthly with a cleaning solution and tissue.

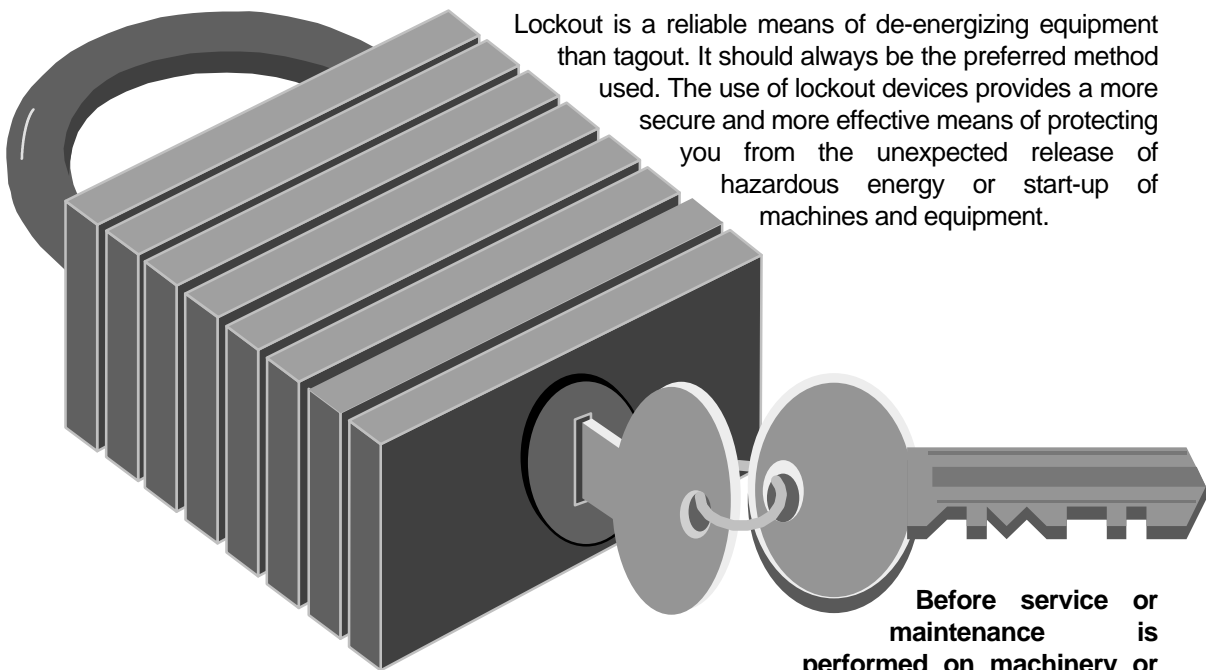
5. **Respiratory protective devices protect your health. They fall into three classes. Which of the following items is not a class of respiratory protective devices?**
- a) Air purifying.
 - b) Atmosphere or air supplying.
 - c) Combination atmosphere level de-contaminator.
 - d) Combination air purifying and supplying.
6. **Most workers who suffer impact injuries to the head were not wearing head protection. Hard hats do not:**
- a) Resist penetration and absorb the shock of a blow.
 - b) Protect your head from acids and extreme heat.
 - c) Protect your head from falling or flying objects.
 - d) Protect against electrical shock.
7. **For protection of your feet and legs from falling or rolling objects, sharp objects, molten metal, hot surfaces, and wet slippery surfaces, which item below can catch on something and cause you to trip?**
- a) Foot guards, safety shoes, boots and leggings.
 - b) Leggings that protect your lower legs and feet.
 - c) Heat-resistant soled and steel-toed shoes.
 - d) Aluminum foot guards worn over work shoes.
8. **Electrical protective devices such as insulating blankets, matting, covers, line hose, gloves, and sleeves made of rubber must meet certain requirements. Which item below is not a requirement?**
- a) Electrical properties.
 - b) Flame retardant rating.
 - c) Workmanship.
 - d) Finish.

9. Companies require you to use hand protection when your hands are exposed to hazards. Which statement below is not a hazard for wearing hand protection?
- a) Machine shop equipment such as drill presses.
 - b) Skin absorption of harmful substances.
 - c) Chemical and thermal burns and harmful temperature extremes.
 - d) Severe abrasions, cuts, lacerations or punctures.
10. Exposure to high noise levels can cause permanent hearing loss or impairment. Glasses, long sideburns, long hair, and facial movements can reduce your protection. Which statement below does not work as protection?
- a) Waxed cotton, foam, or fiberglass wool earplugs.
 - b) Disposable earplugs, used one time and then thrown away.
 - c) Slightly moistened and sterilized plain cotton balls.
 - d) Earmuffs that make a perfect seal around the ear.

7. Lockout/Tagout

Introduction

In September of 1989, OSHA issued a standard for the Control of Hazardous Energy. This standard helps safeguard you from hazardous energy while you are performing service or maintenance on machines and equipment. The standard identifies the practices and procedures necessary to **shut down** and **lock out** or **tag out machines and equipment**, requires that you receive training in your role in a lockout/tagout, and that inspections are conducted to maintain the energy control program.



Lockout is a reliable means of de-energizing equipment than tagout. It should always be the preferred method used. The use of lockout devices provides a more secure and more effective means of protecting you from the unexpected release of hazardous energy or start-up of machines and equipment.

Before service or maintenance is performed on machinery or equipment, the machinery or equipment must be turned off and disconnected from the energy source, and the energy-isolating device must be either locked or tagged out. Following this rule can eliminate nearly 2% of all workplace deaths and can have a significant impact on worker safety and health in the U.S.

39 million workers are protected by this rule. More than a million workers actually service equipment - like craft workers, machine operators, and laborers – and face the greatest risk. Following this standard will prevent about 122 fatalities, 28,400 lost workday injuries, and 31,900 non-lost workday injuries each year.

Purpose

Lesson 7 is about safety protection while maintaining and servicing equipment.

Objectives

You learn how to prepare and use lockout and tagout procedures to protect you and other employees from dangerous situations through proper communications.

Outcomes

In Lesson 7 you are taught about lockout and tagout. This includes the standard, normal production operation, servicing and maintenance operations and minor servicing tasks.

The procedures of locking and tagging equipment are important to your safety. That's why you will learn details about the energy control program, energy control procedure, energy-isolating devices, the requirements for lockout/tagout devices, employee training, inspections, application of controls and lockout/tagout devices, removal of locks and tags, and additional safety requirements.

Finally, a Glossary is provided to assist you in terms that are used.

Quiz

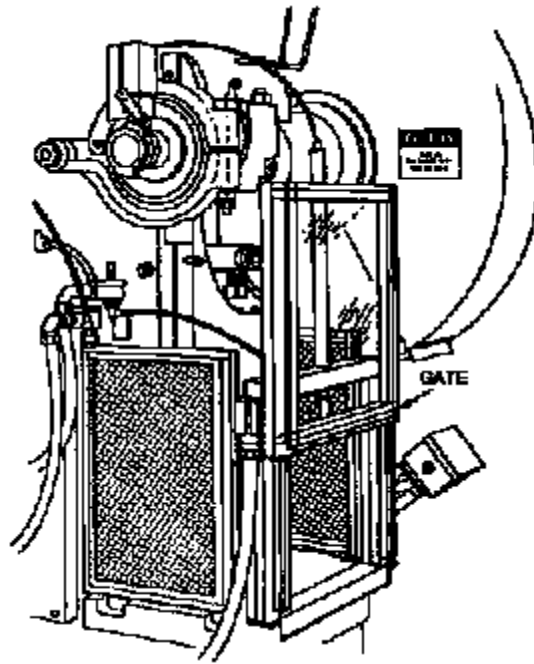
1. Lockout means?
 - A) Being locked out of a building.
 - B) The opposite of a lock in.
 - C) Using a keyed lock.
 - D) Leaving a lock outdoors.

2. When servicing equipment, do not:
 - A) Tag the equipment.
 - B) Measure stored energy.
 - C) Stop the equipment.
 - D) Isolate equipment from energy.

3. Who should remove a lock or tag?
 - A) You can.
 - B) Your Supervisor.
 - C) The person that placed the lock or tag.
 - D) A qualified electrician.

Lockout/Tagout

The



The lockout/tagout standard is for general industry workers. It covers the servicing and maintenance of machines and equipment from unexpected start-up or release of stored energy that could cause injury to employees. If you are performing service or maintenance tasks that don't expose you to the unexpected release of hazardous energy, this standard doesn't apply.

Standard

The standard defines requirements for the control of hazardous energy.

- While you are servicing or maintaining **cord** and **plug** connected electrical equipment, the safety hazards are controlled by unplugging the equipment from the energy source. The plug must be under your control when you are performing the service and/or maintenance.
- You must be in control during **hot tap operations** involving transmission and distribution systems for gas, steam, water, or petroleum products when they are performed on pressurized pipelines. When the service must continue to provide energy and shutdown of the system is impractical, you are provided with an alternative type of protection that is equally effective.

Normal Production Operation

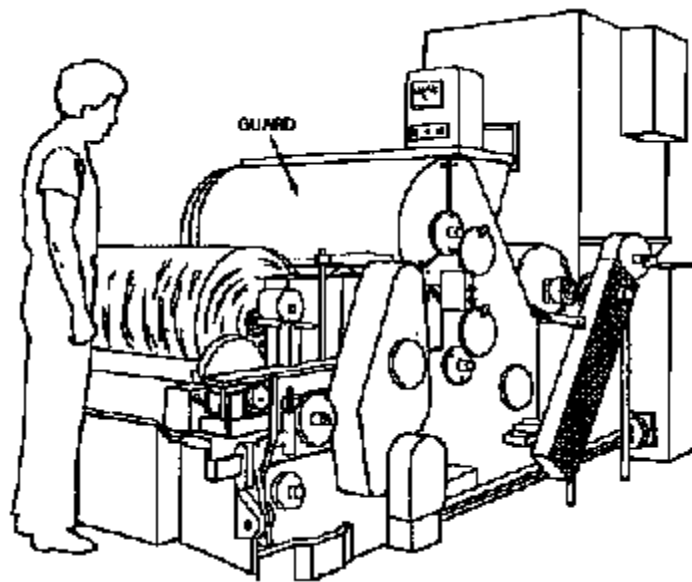
Machines and equipment create many hazardous situations during normal production operations, for example, whenever machines and equipment are used to perform their usual function. In certain cases, potential hazards during normal production operation can be covered by the lockout/tagout rule.

Servicing and Maintenance Operations

If an activity such as lubricating, cleaning, or removing a jam from the production equipment takes place **during** production, you can be exposed to hazards that aren't part of the production operation itself. You must use lockout/tagout when any of the following conditions occurs:

- If you must remove or bypass machine guards or other safety devices, resulting in exposure to hazards at the point of operation;
- If you are required to place any part of your body in contact with the point of operation of the operational machine or piece of equipment; or
- If you are required to place any part of your body into a danger zone associated with a machine operating cycle.

In these situations, the equipment must be de-energized and locks or tags are applied to the energy-isolation devices.



When you are doing normal servicing tasks, such as setting equipment up or making significant adjustments to machines, that don't occur during normal production operations, you are required to lock out or tag out if you can be injured by unexpected energizing of the equipment.

Some servicing operations have to be performed with the power on. Some of these include making fine adjustments, centering the belt on conveyors, troubleshooting the source of the problem or checking to make sure that a problem has been corrected. Although a power-on condition is needed to accomplish a particular type of servicing or to verify that it was performed properly, lockout or tagout procedures are required when servicing or maintenance occurs with the power off.

Minor Servicing Tasks

If you are performing **minor** tool changes, adjustments or other minor service activities that are **routine**, **repetitive**, and **integral** to the use of the production equipment, you aren't required to use the lockout/tagout standard, if the work is performed using alternative measures that give you effective protection.

Procedures

Your company has procedures for isolating machines or equipment. They are for protecting you from the input of energy. You put on locks or tags to energy-isolating devices that prevent any unexpected energizing, start-up, or release of stored energy that could injure you. When tags are used on energy-isolating devices that can be locked out,

the company provides additional means to provide a level of protection equivalent to that of locks.

Energy Control Program

The lockout/tagout rule requires companies to have a program to make sure that machines and equipment are isolated and inoperative before you perform service or maintenance where the unexpected energizing, start-up or release of stored energy could occur and cause you injury.

Whenever the possibility of unexpected machine or equipment start-up exists or the unexpected release of stored energy could occur and cause injury, the equipment is isolated from its energy sources and made inoperative prior to servicing or maintenance.

Energy Control Procedure

Energy control procedures are used to control potentially hazardous energy sources whenever you perform activities.

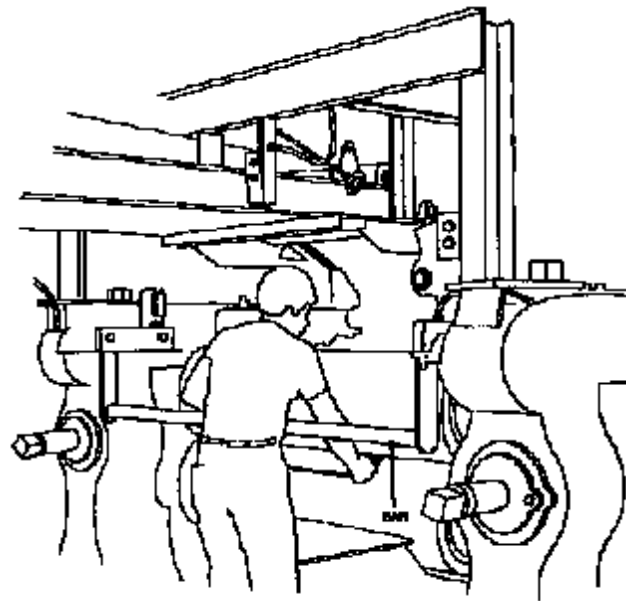
The written procedures identify the information that you must know in order to protect you from hazardous energy during service or maintenance.

The energy control procedure outlines the purpose, authorization, rules and techniques used to control hazardous energy sources and the means used to enforce compliance. At a minimum it includes the following elements:

- A statement on when the procedure will be used;
- The steps needed to shut down, isolate, block, and secure machines or equipment;
- The steps for the safe placement, removal, and transfer of lockout/tagout devices and who has the responsibility for them; and
- The specific requirements for testing machines or equipment to determine and verify the effectiveness of locks, tags, and other energy control measures.

The procedure includes the following steps:

- (1) preparing for shutdown,



- (2) shutting down the machines or equipment,
- (3) isolating the machine or equipment from the energy sources,
- (4) applying the lockout or tagout devices,
- (5) safely releasing all potentially hazardous stored or residual energy,
and
- (6) Verifying the isolation of the machines or equipment prior to the start of service or maintenance work.

Before lockout or tagout devices are removed and energy is restored to the machines or equipment, steps are taken to re-energize equipment after service is completed, including:

- (1) assuring that machines or equipment components are operationally intact;
- (2) Notifying employees that the person who applied the device removes lockout or tagout devices from each energy-isolating device.

Energy-Isolating Devices

The primary tool for providing protection is the energy-isolating device. This identifies the mechanism to prevent the transmission or release of energy that all locks or tags are attached to. This device guards you against accidental machine or equipment start-up or the unexpected re-energizing of equipment during servicing or maintenance. There are two types of energy-isolating devices: those able to be locked and those that aren't.



When the energy-isolating device can't be locked out, you must use tagout. A Company can modify or replace a device to make it capable of being locked. When using tagout, you must follow all tagout rules. In addition to the normal training, you must be trained in the following limitations of tags:

- Tags are warning devices attached to energy-isolating devices and don't provide the physical restraint of a lock.
 - When a tag is attachment to an isolating means, it isn't to be removed except by the person who applied it, and it is never to be bypassed, ignored, or defeated.
-
- Tags must be legible and understandable by everyone.
 - Tags and their means of attachment are made of materials that withstand the environmental conditions in the workplace.
 - Tags can evoke a false sense of security. They are only one part of an overall energy control program.

- Tags must be securely attached to the energy-isolating devices so that they can't be detached accidentally during use.

If the energy-isolating device is lockable, you use locks unless you can prove that the use of tags provides protection **at least as effective as** locks and assures "full employee protection."

Full employee protection includes complying with all tagout rules plus additional safety measures that provide safety equivalent to using lockout. This includes removing and isolating a circuit element, blocking a controlling switch, opening an extra disconnecting device, or removing a valve handle to reduce the potential for any inadvertent energizing.

Whenever major replacement, repair, renovation or modification of machines or equipment is performed and new machines or equipment are installed, you must make sure that the energy-isolating devices for machines or equipment are lockable. All newly purchased equipment must be lockable.



Requirements for Lockout/Tagout Devices

When attached to energy-isolating device, both lockout and tagout devices are tools that you use to help protect you from hazardous energy. The lockout device provides protection by holding the energy-isolating device as a source of potential danger. It indicates that the energy-isolating device and equipment being controlled can't be

operated until the tagout device is removed. Whichever devices are used, they must be singularly identified, must be the *only* devices used for controlling hazardous energy, and must meet the following requirements:

- **Durable** - *Lockout* and *tagout* devices withstand the environment that they are exposed to for the duration of the expected exposure. *Tagout* devices are constructed and printed so that they don't deteriorate or become illegible, especially when used in corrosive acid, alkali chemicals or wet environments.
- **Standardization** - Both *lockout* and *tagout* devices are standardized according to **color**, **shape**, or **size**. *Tagout* devices are also standardized according to **print** and **format**.
- **Substantial** - *Lockout* and *tagout* devices are substantial enough to minimize early accidental removal. *Locks* are substantial to prevent removal except by excessive force of special tools such as bolt cutters or other metal cutting tools. *Tag means of attachment* is non-reusable, attached by hand, self-locking and non-releasable, with an unlocking strength of at least 50 pounds.

- The device for attaching the tag has the general design and basic characteristics equivalent to a one-piece nylon cable tie to withstand all environments and conditions.
- **Identifiable** - *Locks* and *tags* clearly identify the person who applies them. *Tags* warn against hazardous conditions if the machine or equipment is energized and includes a legend such as the following: **DO NOT START, DO NOT OPEN, DO NOT CLOSE, DO NOT ENERGIZE, and DO NOT OPERATE.**

Employee Training

Your company provides training. There are three types of employees - **authorized**, **affected**, and **other**. The amount of training that each employee receives is based on

- (1) the relationship of your job to the machine or equipment being locked or tagged out, and
- (2) The degree of knowledge relevant to hazardous energy that you have.

For example, the training program for **authorized** employees (those who are charged with the responsibility for implementing the energy control procedures and performing the service and maintenance) covers the following areas:

- Details about the type and magnitude of the hazardous energy sources present in the workplace, and
- The methods and the needs necessary to isolate the control of the energy sources.

Affected employees, usually the machine operators or users, and all **other** employees need to be able to

- (1) recognize when the control procedure is being implemented, and
- (2) Understand the purpose of the procedure and the importance of not attempting to start up or use the equipment that has been locked or tagged out.

Because an "affected" employee isn't performing the service of maintenance, that employee's responsibilities under the energy control program are simple: **Whenever there is a lockout or tagout device in place on an energy-isolating device, the affected employee leaves it alone and does not attempt to operate the equipment.**

Every training program makes sure that **all** employees understand the purpose, function and restrictions of the energy control program and that **authorized** employees have the knowledge and skills necessary for the safe application, use, and removal of energy controls.

Training programs deal with the equipment, types of energy, and hazards specific to the workplace being covered.

Inspections

Inspections are performed annually to make sure that the energy control procedures (locks and tags) are implemented properly and that you are familiar with your responsibilities.

Application of Controls and Lockout/Tagout Devices

The procedure for applying energy controls includes the specific actions that are done in sequence. These are identified as follows:

- (1) Prepare for shut down.
- (2) Shut down the machine or equipment.
- (3) Apply the lockout or tagout device.
- (4) Render safe all stored or residual energy.
- (5) Verify the isolation and de-energizing of the machine or equipment.

Removal of Locks and Tags

Before lockout or tagout devices are removed and energy is restored to the machine or equipment, the authorized employees takes the following actions:

- (1) **Inspect** the work area to make sure that non-essential items are removed and that machine or equipment components are intact and cable of operating properly;
- (2) **Check** the area around the machine or equipment to make sure that all employees are safely positioned or removed;
- (3) **Notify** affected employees immediately after removing locks or tags and before starting equipment or machines; and
- (4) **Make sure** that ONLY the person that put them on removes locks and tags.

Additional Safety Requirements

Special circumstances exist when

- (1) machines need to be tested or repositioned during servicing,
- (2) outside contractors are at the work site,
- (3) servicing or maintenance is performed by a group (rather than one specific person), and
- (4) Shifts or personnel changes occur.

- **Test or positioning of machines.** The temporary removal of locks or tags and the re-energizing of the machine or equipment are allowed **ONLY** when necessary under special conditions. For example, when power is needed for the testing or positioning of machines, equipment, or components. The re-energizing is conducted with the sequence of steps listed below:
 - (5) Clear the machines or equipment of tools and materials.
 - (6) Remove employees from the machines or equipment area.
 - (7) Remove the lockout or tagout devices.
 - (8) Energize and proceed with testing or positioning.
 - (9) De-energize all systems, isolate the machine or equipment from the energy source, and reapply lockout or tagout devices.
- **Outside personnel and contractors.** The onsite employer and the outside employer inform each other of their lockout or tagout procedures. Each employer makes sure that personnel understand and comply with all restrictions of the other employer's energy control program.
- **Group Lockout or tagout.** During all group lockout/tagout operations where the release of hazardous energy is possible, a personal lockout or tagout device that gives protection protects the authorized employee performing service or maintenance.
- **Shift or personnel changes.** Specific procedures make sure the continuity of lockout or tagout protection during shift or personnel changes.

Glossary

Affected employee - An employee who performs their job in an area where the energy control procedure is implemented and servicing or maintaining operations are performed. An affected employee **doesn't** perform servicing or maintenance on machines or equipment and, consequently, isn't responsible for implementing the energy control procedure. An affected employee becomes an "authorized" employee whenever they perform servicing or maintenance functions on machines or equipment that must be locked or tagged.

Authorized employee - An employee who performs servicing or maintenance on machines and equipment. These employees for their own protection use lockout or tagout.

Capable of being locked out - An energy-isolating device is considered capable of being locked out if it meets one of the following requirements:

- It is designed with a hasp that a lock can be attached to;

- It is designed with other integral parts that a lock can be attached to;
- It has a locking mechanism built into it; or
- It can be locked without dismantling, rebuilding, or replacing the energy-isolating device or permanently altering its energy control capability.

Energized - Machines and equipment are energized when (1) they are connected to an energy source or (2) they contain residual or stored energy.

Energy-isolating device - Any mechanical device that physically prevents the transmission or release of energy. These include manually operated electrical circuit breakers, disconnect switches, line valves, and blocks.

Energy source - Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Energy control procedure - A written document that contains information an authorized employee needs to know in order to safely control hazardous energy during servicing or maintenance of machines or equipment.

Energy control program - A program to prevent the unexpected energizing or the release of stored energy in machines or equipment where employees perform servicing or maintenance. The program consists of energy control procedure(s), employee training program, and periodic inspections.

Lockout - The placement of a lockout device on an energy-isolating device, with an established procedure, so that the energy-isolating device and the equipment being controlled can't be operated until the lockout device is removed.

Lockout device - Any device that uses a positive means, such as a key or combination lock, to hold an energy-isolating device in a safe position, preventing the energizing of machinery or equipment. A blank flange or bolted slip blind are considered equivalent to lockout devices.

Tagout - The placement of a tagout device on an energy-isolating device, according to an established procedure, to indicate that the energy-isolating device and the equipment being controlled can't be operated until the tagout device is removed.

Tagout device - Any warning device, such as a tag and a means of attachment, that can be securely fastened to an energy-isolating device according to a procedure. The tag indicates that the machine or equipment that it is attached to isn't operated on until the tagout device is removed according to the energy control procedure.

Summary

A detailed outline of Lesson 7 summarizes each area that you learned as follows:

A. Lockout/Tagout

B. Normal Production Operation

1. Servicing and Maintenance Operations
2. Minor Servicing Tasks

C. Procedures

1. Energy Control Program
2. Energy Control Procedure
3. Training
4. Inspections
5. Application of Controls and Lockout/Tagout Devices
6. Removal of Locks and Tags
7. Additional Safety Requirements

D. Glossary

Lesson 7 Test – Lockout/Tagout

1. **The standard for the control of hazardous energy helps safeguard you while you are performing maintenance on machines and equipment. The standard identifies the procedures necessary to do all of the things below except for which one?**
 - a) Shut down and lock out or tag out of machines and equipment.
 - b) Training in your role in a lockout/tagout.
 - c) Reducing or eliminating at least 2% of all workplace deaths.
 - d) Inspections to maintain the energy control program.
2. **The lockout/tagout standard covers the servicing and maintenance of machines and equipment from unexpected start-up or release of stored energy that could cause injury to employees. Which statement is false?**
 - a) When the service must continue to provide energy and shutdown of the system is impractical, you are provided with an alternative type of protection that is equally effective.
 - b) While you are servicing or maintaining cord and plug connected electrical equipment, the safety hazards are controlled by unplugging the equipment from the energy source.
 - c) Even when you are performing service or maintenance tasks that don't expose you to the unexpected release of hazardous energy, this standard applies.
 - d) You must be in control during hot tap operations involving transmission and distribution systems for gas, steam, water, or petroleum products when they are performed on pressurized pipelines.
3. **If an activity such as lubricating, cleaning, or removing a jam from the production equipment takes place during production, you can be exposed to hazards that aren't part of the production operation itself. You must use lockout/tagout when certain conditions occur. Which condition is false?**
 - a) If you must remove or bypass machine guards or other safety devices, resulting in exposure to hazards at the point of operation.
 - b) When you are doing normal servicing tasks, such as setting equipment up or making significant adjustments to machines, that don't occur during normal production operations, you are not required to lock out or tag out the equipment.
 - c) If you are required to place any part of your body in contact with the point of operation of the operational machine or piece of equipment.
 - d) If you are required to place any part of your body into a danger zone associated with a machine operating cycle.

4. **Whenever the possibility of unexpected machine or equipment start-up exists or the unexpected release of stored energy could occur and cause injury, what does not need to be done prior to servicing or maintenance.**
- a) Isolate equipment from its energy sources.
 - b) Make equipment inoperative.
 - c) Measuring the existing stored energy in the equipment.
 - d) Lock out or tag out the machine equipment.
5. **Energy control procedures are used to control potentially hazardous energy sources whenever you perform activities. These procedures include all steps except for which one?**
- a) Preparing for shutdown and shutting down the machines or equipment.
 - b) Isolating the machine or equipment from the energy sources and applying the lockout or tagout devices.
 - c) Safely releasing all potentially hazardous stored or residual energy and verifying the isolation of the machines or equipment.
 - d) Notifying all affected employees before equipment shutdown and on energizing.
6. **The primary tool for providing protection is the energy-isolating device. This device guards you against accidental machine or equipment start-up or the unexpected re-energizing of equipment. Which statement about energy-isolating devices is false?**
- a) When a tag is attachment to an isolating means, it isn't to be removed except by the person who applied it, and it is never to be bypassed.
 - b) Tags are warning devices attached to energy-isolating devices and don't provide the physical restraint of a lock.
 - c) Tags must be securely attached to the energy-isolating devices so that they can't be detached accidentally during use.
 - d) If the energy-isolating device is lockable, you can use any method to provide protection that is at least as effective as locks.

7. When attached for energy isolating, both lockout and tagout devices are tools that you use to help protect you from hazardous energy. Which statement about a lockout device is false?
- a) It provides protection by holding the energy-isolating device as a source of potential danger.
 - b) It clearly identifies the person who applies the tag and includes the following: DO NOT START, DO NOT OPEN, DO NOT CLOSE, DO NOT ENERGIZE, or DO NOT OPERATE.
 - c) It indicates the energy-isolating device, equipment energy source and rate classification being controlled until the tagout device is removed.
 - d) It is standardized according to color, shape, or size. Tagout devices are also standardized according to print and format.
8. The procedure for applying energy controls includes specific actions that are done in sequence. Which action is not part of the procedure?
- a) Notify employees in the work area about the shut down.
 - b) Shut down the machine or equipment.
 - c) Apply the lockout or tagout device.
 - d) Verify the isolation and de-energizing of the machine or equipment.
9. Before lockout or tagout devices are removed and energy is restored to the machine or equipment, the authorized employee takes certain actions. Which action below is not correct?
- a) Inspect the work area to make sure that non-essential items are removed and that machine or equipment components are intact and cable of operating properly.
 - b) Make sure that only the machine or equipment components are energized prior to the locks and tags removed.
 - c) Check the area around the machine or equipment to make sure that all employees are safely positioned or removed.
 - d) Notify affected employees immediately after removing locks or tags and before starting equipment or machines.
10. Certain terms are important about energy hazards. Which term should be used in this statement? "Machines and equipment are _____ when they are connected to an energy source or they contain residual or stored energy."
- a) An energy-isolating device.
 - b) Considered a tagout device.
 - c) An energized device.
 - d) A lockout device.

8. Materials Handling

Introduction

More employees are injured in industry while moving materials than while performing any other single function. In every day operations, you handle, transport, and store materials. You can do this by hand, by manually operated materials handling equipment, or by power operated equipment.

Purpose

Lesson 8 provides important safety information about handling materials. This includes various kinds of equipment used for materials handling.

Objectives

You learn how to reduce safety risks in handling materials as you do your job.

Outcomes

Lesson 8 details many kinds of materials and handling equipment. Depending on the type of job that you have, you may be exposed to safety risks from some or many of these. Handling materials includes using mechanical equipment, secure storage and housekeeping.

Rim wheels can cause safety hazards. These can include the various types of wheels/tires, hazards, based on appropriate employee training, the servicing equipment, and the safe operating procedures for multi-piece and single-piece rim wheels.

If you will use powered industrial trucks, you will better understand the designations, safety guards, the changing and charging storage batteries, trucks and railroad cars, operating training requirements, truck operations, traveling, loading, operation of the truck and maintenance of industrial trucks.

Other types of equipment include overhead and gantry cranes. The various pieces will be described such as cabs, footwalks and ladders, stops, bumpers, rail sweeps and guards. This will include inspection and handling the load.



Crawler locomotive and truck cranes safety information will include inspection, handling the load and operating near electric power lines.

The general requirements for derricks will be discussed, including their load ratings, inspection, handling the load and other requirements.

Helicopter safety includes the slings and tag lines, cargo hooks, personal protective equipment, loose gear housekeeping, hooking and unhooking loads, static charge, signal systems, approach distance and communications. Also the safe operating practices and inspection of slings will include alloy steel chain slings, wire rope slings, metal mesh slings, safe operating temperatures and synthetic web slings.

Quiz

1. Which word does not relate to safe materials storage?

- A) Tripping.
- B) Fire.
- C) Moisture.
- D) Pests.

2. What is a rim wheel?

- A) The area around a steering wheel.
- B) A part of a vehicle axle.
- C) Used to hold a tire.
- D) The spare tire.

3. The biggest hazard with materials handling is:

- A) Attaching the load.
- B) Overloading the load.
- C) Moving the load.
- D) Holding the load.

Handling Materials

Using Mechanical Equipment

Where mechanical handling equipment is used, sufficient safe clearance is allowed for aisles, at loading docks, through doorways, and whenever turns or passage are made.

Permanent aisles and passageways are appropriately marked.

Secure Storage

Storage of material doesn't create a hazard. All stored materials stacked in tiers are stacked, blocked, interlocked, and limited in heights so that they are secure against sliding or collapse.

Housekeeping

Storage areas are kept free from accumulation of materials that create hazards from tripping, fire, explosion or pest harborage.

Rim Wheels

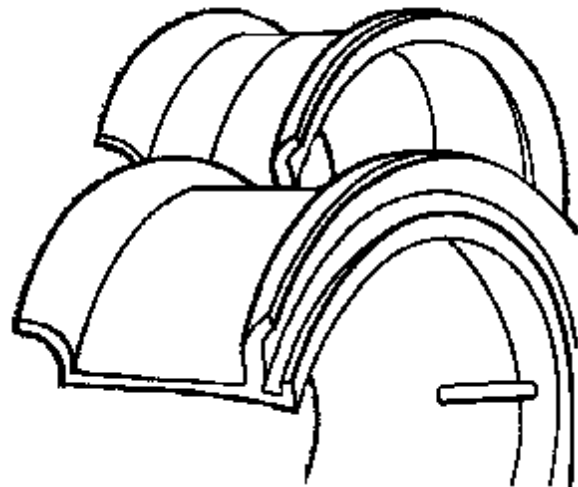
The safety standard includes requirements for the safe servicing of multi-piece and single-piece rim wheels used on large trucks, trailers, buses, and off-road machines.

322,000 employees in over 100,000 workplaces service large vehicle tires that are mounted on either multi-piece or single-piece wheels.

There has been over a 70-percent reduction in multi-piece rim wheel servicing injuries since the original standard was issued in 1980. This includes single-piece rim wheel servicing where workers face risk of serious injury or death.

The standard requires:

- training for all tire servicing employees,
- utilization of industry-accepted procedures that minimize the potential for employee injury,
- use of proper equipment such as clip-on chucks,



- restraining devices or barriers to retain the wheel components in the vent of an incident during the inflation of tires, and
- Use of compatible components.

Types of Wheels/Tires

A rim wheel is the component assembly of wheel (either multi-piece or single-piece), tire and tube, plus other components.

A single-piece wheel is the other component of the assembly used to hold the tire, form part of the air chamber (with tubeless tires), and provides the way of attaching the assembly to the vehicle axle. A multi-piece wheel is a vehicle wheel consisting of two or more parts, one is a side or locking ring that holds the tire and other components on the rim wheel by interlocking the components when the tire is inflated.

The standard doesn't apply to the servicing of rim wheels utilizing automobile tires or truck designated "LT."

Hazards

The difference between accidents involving single-piece rim wheels and those involving multi-piece rim wheels is the effect of the sudden release of the pressurized air contained in a single-piece rim wheel.

In a multi-piece rim wheel accident, the wheel components separate and are released from the rim wheel with force. The severity of the hazard is related to the air pressure and to the air volume.

Single-rim wheel accidents occur when the pressurized air contained in the tire is suddenly released, whether by the bead breaking or the bead slipping over the rim flange. The principal hazards involve pressurized air that, once released, can pick up and hurl you across the shop if you are in close to the rim wheel and within the trajectory. Or it can propel the rim wheel in any potential path or route (basically along the axis of the rim wheel) that a rim wheel component can travel during an explosive separation, or the area that the air blast from a single-piece rim wheel can be released.

Employee Training

The company provides a program to train all employees who service rim wheels in the hazards involved and the safety procedures to be followed.

The company makes sure that no employee services any rim wheels unless the worker has been instructed in correct procedures of mounting, removing, and servicing activities and the safe operating precautions for the type of wheel being serviced.

The company makes sure that you demonstrate and have the ability to service rim wheels safely by correctly performing the following tasks:

- Removing tires, including deflation
- Inspecting and identifying rim wheel components

- Mounting tires, including inflating them with a restraining device or other safeguard.
- Handling rim wheels
- Inflating tires when single-piece rim wheels are mounted on a vehicle
- Understanding the necessity of standing outside the trajectory during inflation of the tires and of inspecting the rim wheels following inflation
- Installing and removing rim wheels

The company evaluates your performance and provides additional training, as necessary, to assure that you maintain your proficiency.

The Servicing Equipment

The company furnishes restraining devices for inflating a tire on a multi-piece wheel, and provides a restraining device or barrier for inflating a tire on a single-piece wheel unless the single-piece rim wheel is bolted onto a vehicle during inflation.

The restraining device can be a cage, rack or an assemblage of bars and other parts that confine all rim wheel components during an explosive separation of the multi-piece rim wheel or during the sudden release of the contained air of a single-piece rim wheel.

A barrier can be a fence, wall, or other structure or object put between a single-piece rim wheel and you during tire inflation to confine the rim wheel components in the sudden release of contained air. Each barrier or restraining device is able to withstand the maximum force of an explosive rim wheel separation or release of the pressurized air.

Restraining devices showing defects must be immediately removed from service:

- Cracks at welds
- Cracked or broken components
- Bent or sprung components caused by mishandling, abuse, tire explosion, or rim wheel separation
- Component pitted due to corrosion or other structural damage that would decrease its effectiveness

Restraining devices or barriers removed from service aren't returned to service until they are repaired and re-inspected. Restraining devices or barriers requiring structural repair such as component replacement or re-welding can't be returned to service until they are certified.

Current charts or rim manuals containing instructions for the types of wheels being serviced are available in the service area, including mobile service units.

Only tools that are recommended in the rim manual can be used for the type of wheel being serviced.

The company supplies air line equipment with a clip-on chuck with a sufficient length of hose between the chuck and in-line valve or regulator to allow you to stand outside the trajectory, as well as an in-line valve with a pressure gauge or a regulator.

The bead diameter and tire-wheel width size and type of both the tire and wheel are checked for compatibility prior to assembly of the rim wheel. Mismatching of half sizes such as 16-inch and 16 1/2-inch tires and wheel must be avoided.

Multi-piece wheel components can't be interchanged except as indicated in the rim manuals.

Multi-piece wheel components and single-piece wheels are inspected prior to assembly. Any wheel or wheel component that is bent out of shape, pitted from corrosion, broken, or cracked must be marked or tagged "unserviceable" and removed from the service area. Damaged or leaky valves must be replaced.

Rim flanges, rim gutters, rings, and the bead-seating areas of wheels must be free of any dirt, surface rust, scale, or loose or flaked rubber buildup prior to tire mounting and inflation.

Safe Operating Procedures: Multi-Piece Rim Wheels

Use the following steps for safe operating procedures:

1. The tire must completely deflated by removing the valve core before a rim wheel is removed from the axle in the following situations:
 - When the tire has been driven under-inflated at 80 percent or less of its recommended pressure, or
 - When there is obvious or suspected damage to the tire or wheel components
2. The tire must be completely deflated by removing the valve core before removing.
3. A rubber lubricant must be applied to the bead and rim mating surfaces when assembling the wheel and inflating the tire unless the tire or wheel manufacturer recommends against its use.
4. If a tire on a vehicle is under-inflated but has more than 80 percent of the recommended pressure, the tire can be inflated while the rim wheel is on the vehicle, provided remote control inflation equipment is used, and you don't remains in the trajectory during inflation.
5. The tire must be inflated outside a restraining device only to a pressure sufficient to force the tire bead onto the rim ledge and create an airtight seal with the tire and bead.
6. Whenever a rim wheel is in a restraining device, you must not rest or lean any part of your body, or equipment, on or against the restraining device.

7. After tire inflation, the tire and wheel must be inspected while still within the restraining device to make sure that they are properly seated and locked. For additional adjustments, deflate the tire by removing the valve core before making the adjustment.
8. An attempt must not be made to correct the seating of side and lock rings by hammering, striking, or forcing the components while the tire is pressurized.
9. Cracked, broken, bent, or otherwise damaged wheel components must not be reworked, welded, brazed, or otherwise heated. Heat must not be applied to a multi-piece wheel.
10. Whenever multi-piece rim wheels are being handled, you must stay out of the trajectory unless your supervisor can show that performance of the servicing makes your presence in the trajectory necessary.

Safe Operating Procedures: Single-Piece Rim Wheels

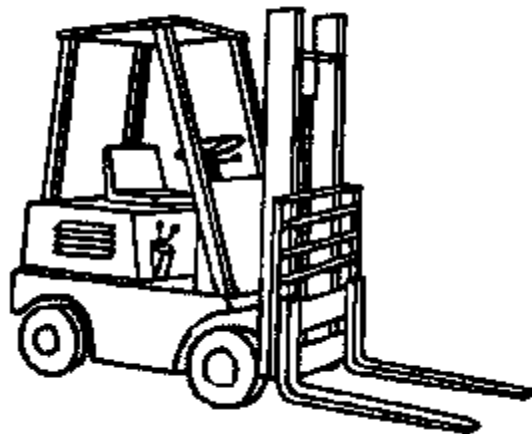
Use the following steps for safe operating procedures with single-piece wheels:

1. The tire must be completely deflated by removing the valve core before removing.
2. Mounting and removing of the tire must be performed only from the narrow ledge side of the wheel. Care must be taken to avoid damaging the tire beads, and the tire must be mounted only on a compatible wheel of mating bead diameter and width.
3. A nonflammable rubber lubricant must be applied to bead and wheel mating surfaces before assembling the rim wheel, unless the tire or wheel manufacturer recommends against the use of any rubber lubricant.
4. If a tire-changing machine is used, the tire can be inflated only to the minimum pressure necessary to force the tire bead onto the rim ledge and create an airtight seal before removal from the tire-changing machine.
5. If a bead expander is used, it must be removed before the valve core is installed and as soon as the rim wheel becomes airtight (when the tire bead slips onto the bead seat).
6. The tire can be inflated only when contained within a restraining device, positioned behind a barrier, or bolted on the vehicle with the lug nuts fully tightened.
7. The tire must not be inflated when any flat, solid surface is in the trajectory and within 1 foot of the sidewall.

8. The tire must not be inflated to more than the inflating pressure stamped in the sidewall unless the manufacturer recommends a higher pressure.
9. You must stay out of the trajectory when a tire is being inflated.
10. Heat must not be applied to a single-piece wheel.
11. Cracked, broken, bent, or otherwise damaged wheels must not be reworked, welded, brazed, or otherwise heated.

Powered Industrial Trucks

This section deals with fire protection; maintenance and use of fork trucks, tractors, platform lift trucks, motorized hand trucks, and other specialized industrial trucks powered by electric motors or internal combustion engines. It doesn't apply to compressed air or nonflammable compressed gas-operated industrial trucks, farm vehicles or vehicles intended for earth moving or over-the-road hauling.



Approved powered industrial trucks must have a label or some other identifying mark indicating approval by the testing laboratory.

Designations

There are eleven different designations of industrial trucks or tractors:

1. Diesel engine powered units having minimum acceptable safeguards against inherent fire hazards.
2. Diesel powered units that are provided with additional safeguards to the exhaust, fuel, and electrical systems.
3. Diesel powered units that don't have any electrical equipment including the ignition and are equipped with temperature limitation features.
4. Electrically powered units that have minimum acceptable safeguards against inherent fire hazards.
5. Electrically powered units that are provided with additional safeguards to the electrical system to prevent emission of hazardous sparks and to limit surface temperatures.

6. Electrically powered units that have the electric motors and all other electrical equipment completely closed.
7. Electrically powered units where the electrical fittings and equipment are designated constructed and assembled so that the units can be used in certain atmospheres containing flammable vapors or dusts.
8. Gasoline powered units having minimum acceptable safeguards against inherent fire hazards.
9. Gasoline powered units that are provided with additional safeguards to the exhaust, fuel, and electrical systems.
10. Liquefied petroleum gas is used for fuel instead of gasoline.
11. Liquefied petroleum gas powered units that are provided with additional safeguards to the exhaust, fuel, and electrical systems.

Atmospheres or locations throughout the plant must be classified hazardous or non-hazardous prior to the consideration of industrial trucks being used.

Safety Guards

All high life rider trucks are fitted with overhead guards where overhead lifting is performed.

If a powered industrial fork truck carries a load that presents a hazard of falling back onto the operator, it must be equipped with a vertical load back rest extension.

Changing and Charging Storage Batteries

Workplaces using electrically powered industrial trucks have battery-changing areas somewhere in the plant. In many cases, depending on the number of electrically powered industrial trucks, there is more than one changing and charging areas associated with powered industrial trucks. It doesn't apply to areas where other batteries, such as those used in motor vehicles (cars or trucks), are changed, although some of the same hazardous conditions can exist.

Some of the requirements include:

- Battery charging installations are located in areas designated for that purpose.
- Facilities are provided for flushing and neutralizing spilled electrolyte, for fire protection, for protecting charging apparatus from damage by trucks, and for adequate ventilation for dispersal of air contaminants from gassing batteries.
- A conveyor, overhead hoist, or equivalent material handling equipment is provided for handling batteries.
- Smoking is prohibited in charging area.

- Precautions are taken to prevent open flames, sparks, or electric arcs in battery charging areas.

Trucks and Railroad Cars

In the receiving and shipping areas, powered industrial trucks are often utilized to load and unload materials from trucks and railroad cars. The brakes of highway trucks are set and wheel locks put under the rear wheels to prevent trucks from rolling while they are boarded with powered industrial trucks.

Wheel stops or other positive protection is provided to prevent railroad cars from moving during loading or unloading operations.

Fixed jacks can be necessary to support a semi-trailer and prevent unending during the loading or unloading when the trailer is not coupled to a tractor.

Operating Training

No employee, including supervisory personnel, is permitted to operate a powered industrial truck unless properly trained and authorized to do so.

Truck Operations

Some of the requirements regarding industrial truck operations include:

- No person is allowed to stand or pass under the raised portion of any truck, whether loaded or empty.
- Unauthorized personnel can't ride on powered industrial trucks. A safe place to ride is provided where riding of trucks is authorized.
- When a powered industrial truck is left unattended, load-engaging means is fully lowered, controls are neutralized, power is shut off, and brakes set. Wheels are blocked if the truck is parked on an incline. A powered industrial truck is "unattended" when the operator is 25 ft. or more away from the vehicle that remains in his view, or whenever the operator leaves the vehicle and it isn't in his view.

Traveling

Some requirements for traveling in powered industrial trucks include:

- All traffic regulations are observed including authorized plant speed limits.
- The driver is required to slow and sound the horn at cross aisles and other locations where vision is obstructed. If the load being carried obstructs forward view, the driver is required to travel with the load trailing.
- Railroad tracks are crossed diagonally whenever possible. Parking closer than 8 feet from the center of railroad tracks is not permitted.

- When ascending or descending grades in excess of 10 percent, loaded trucks are driven with the load upgrade.
- Dockboards or bridgeplates are secured before they are driven over. Dockboards or bridgeplates are driven over carefully and slowly and they're rated capacity never exceeded.

Loading

Only loads within the rated capacity of the truck and only stable or safely arranged loads must be handled. Caution must be exercised when handling off-center loads that can't be centered.

Operation of the Truck

If at any time a powered industrial truck is found to be in need of repair, defective, or in any way unsafe, the truck must be taken out of service until it has been restored to safe operating condition.

Fuel tanks can't be filled while the engine is running. Spillage must be avoided. Any spillage of oil or fuel is carefully washed away or completely evaporated and the fuel tank cap put back before restarting the engine.

Open flames can't be used for checking electrolyte level in storage batteries or gasoline level in fuel tanks.

Maintenance of Industrial Trucks

Any power-operated industrial truck not in safe operating condition must be removed from service. Authorized personnel must make all repairs.

Those repairs to the fuel and ignition systems that involve fire hazards must be conducted only in locations designated for such repairs.

Industrial trucks are examined before being put in service, and must not be put in service if the examination shows any condition affecting the safety of the vehicle. Examinations must be made at least daily. Where trucks are used on a round-the-clock basis, they must be examined after each shift.

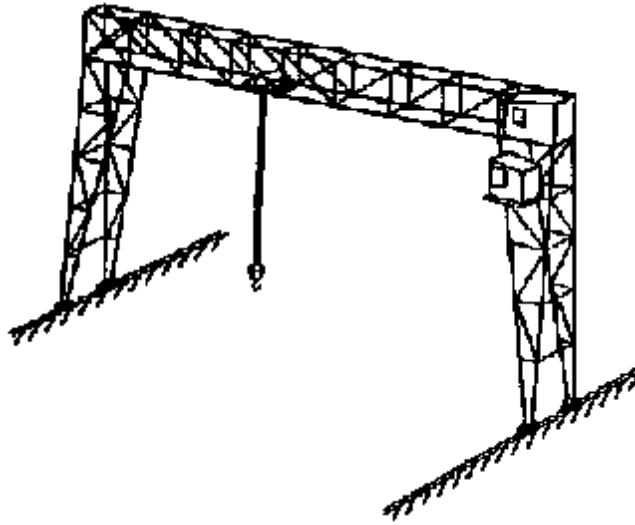
Overhead and Gantry Cranes

This section applies to overhead and gantry cranes, including semi-gantry cantilever gantry, wall cranes, storage bridge cranes, and others having the same fundamental characteristics.

Overhead and/or gantry cranes can't be modified and re-rated unless the supporting structure is checked for the new rated load. It isn't unusual to find instances of overhead or gantry cranes where it was claimed that the lifting capacity was increased simply by installing a new rated load sign on the bridge of the crane.

The rated loads of the crane are plainly marked on each side of the crane. If the crane has more than one hoisting unit, each hoist has its rated load marked on it or on its load block. The potential for overloading the crane increases if the hook-up operator doesn't know the rated capacity.

Only employees selected or assigned by the employer as being qualified to operate a crane are permitted to do so.



Cabs

A cab-operated crane is an overhead or gantry crane controlled by an operator in a cab located on the bridge or trolley. The general arrangement of the cab and the location of control and protective equipment are such that all operating handles are within convenient reach of the operator when facing the area to be served by the load hook, or while facing the direction of travel of the cab. The arrangement must allow a full view of the load hook in all positions.

The access to all cab-operated cranes is checked thoroughly. Serious injuries occur because of the following three conditions:

1. There was no convenient fixed ladder, stairs, or platform provided to reach the cab or bridge footwalk. It is unacceptable and poses a significant hazard to allow you to board a crane by climbing over guardrails, over, under, and around building structures, energized hot rails, portable ladders or movable platforms.
2. There was a gap exceeding 12 inches between a fixed ladder, stairs or platform and access to the cab or bridge footwalk.
3. The fixed ladder used as access to the crane did not meet the Safety Code. Usual conditions concerning the access ladders are: There are no cages provided for ladders over 20 feet in unbroken length, offset platforms aren't provided, or the ladders themselves aren't maintained in a safe condition.

Footwalks and Ladders

Where sufficient headroom is available on cab-operated cranes, a footwalk is provided on the drive side along the entire length of the bridge of all cranes having the trolley running on top of the girders.

Significant hazards exist for maintenance and inspection personnel if no footwalk is provided. Some examples are work being performed from portable ladders, off the main bridge girder itself without protection against falling to the floor below, or from the trolley platform itself with the same potential for falling to the floor below.

Bridge footwalks are rigid and designed to sustain a distributed load of at least 50 pounds per square foot. In many older workplaces, serious hazards are associated with the bridge footwalk itself. This area can't be inspected from the floor safely. You must climb onto the crane to properly document the hazardous conditions. It is quite common to find bridge footwalks not permanently secured. It must be remembered that at the time of the inspection no employees can be on the footwalks or cranes, maintenance employees, inspection personnel, and the crane operator must go on the bridge footwalk at various times. A common and serious hazard is one where standard railings haven't been provided on all open sides of the bridge footwalk. In addition, toeboards must be installed. The standard railing provisions apply to all sides of the bridge footwalk including the inside edge next to the bridge girders if a fall potential exists.

All gantry cranes are provided with a ladder or a stairway that extends from the ground to the footwalk or the cab platform. It isn't permitted to board a gantry crane by portable ladders, structure of the crane, or any other method.

Any ladder provided on an overhead or gantry crane is permanently and securely fastened in place. Damaged, loose, improperly maintained, or unguarded fixed ladders are common.

Stops, Bumpers, Rail Sweeps and Guards

Stops

A "stop" is a device to limit travel of a trolley. This device normally is attached to a fixed structure and normally doesn't have energy-absorbing ability.

Every overhead or gantry crane, where the trolley runs on top of the bridge girder, has stops at either end of the limits of the travel of the trolley. These stops are fastened to resist forces applied when contacted, and if the stop engages the tread of the wheel of the trolley it has a height equal to the radius of the wheel.

The main hazard with trolley stops is that the trolley could be run off the trolley runway. The hazards present serious injury potential to those on the floor below. The trolley itself could fall to the floor, parts of the trolley could come off the crane structure and hit employees below, the load itself could be dropped, or cause the bridge runway conductors, the entire crane could itself be energized.

Another hazardous condition is the failure to re-install crane runway stops at the ends of the limits of travel of the runway. Conditions that occur in overhead crane installations are that the controllers have malfunctioned and become stuck in the open position, and the crane itself has run off the ends of the bridge runway through the building wall.

Bridge and Trolley Bumpers

A "bumper" (buffer) is an energy-absorbing device for reducing impact when a moving crane or trolley reaches the end of its permitted travel, or when two moving cranes or trolleys come in contact.

Overhead or gantry crane bridges have bumpers.

A common condition observed on overhead or gantry cranes is that bumpers aren't provided with energy-absorbing capacity. When an overhead or gantry crane contacts another crane on the same runway or contacts the bridge stops at the end of the runway, a shock is transmitted to the lifting mechanisms that could cause a potential dropping of the load. The constant striking of a crane against another object without energy-absorption buffers causes weakening of the bridge and end structures that can cause cracks in the webbing and lead to failure of the crane structure.

Trolleys are provided with bumpers. If there is more than one trolley operated on the same runway, each trolley has bumpers on its ends. If bumpers are installed on the trolley, they minimize parts falling from the trolley in case of breakage, and are energy absorbing.

Rail Sweeps

Bridge end truck wheels have sweeps that extend below the top of the rail and project in front of the truck wheels. Their lack is a very common condition.

By not having rail sweeps, maintenance equipment could be left on the bridge runway rails, and as the crane travels into this area, could be derailed, causing an unintended movement of the load, a shock load, and potential dropping of the load. This also applies to gantry and semi-gantry cranes where the truck wheels run on a rail usually located on the floor or working surface.

Guards

Hoisting ropes on overhead and gantry cranes must be inspected closely to make sure that they don't run near other parts to make fouling or chafing possible.

If a hoisting rope is chafing, it will eventually wear through or break, and drop the load to the floor. Guards are provided to prevent contact between bridge conductors and hoisting ropes if they could come into contact. The bridge conductors are located on the inside flange on the bridge girders and provide the power to the trolley.

Another very common hazard on overhead or gantry cranes is exposed moving parts not properly guarded. Examples of this are gears on or near the bridge footwalk shaft ends on bridge motors located on the bridge footwalks, and chain and chain sprockets.

There have been fatalities of employees working on bridge footwalks being drawn into open gears, projecting shaft ends and chain and sprocket drives.

Brakes

Each hoisting unit of all cranes has a holding brake, applied directly to the motor shaft or some other part of the gear train.

On cab-operated cranes with the cab on the bridge, a bridge brake is provided.

All floor, remote and pulpit-operated crane bridge drives have a brake or non-coasting mechanical drive to let the crane stop quickly. Overhead or gantry cranes with a cab on the trolley have a trolley brake.

Electrical Equipment

On the floor-operated cranes where a multiple conductor cable is used with a suspended push-button station, the station is supported to protect the electrical conductor against strain. This condition can be avoided by installing a chair or cable from an upper support to the push-button station to take the strain off the conductor.

Pendant control boxes are clearly marked for identification of functions. Lack of clear labeling is quite common.

One of the most serious hazards with cranes concerns the lack of an over-travel limit switch in the hoisting direction. A "limit switch" is a switch that disconnects the power to the drive motor and stops the load if that load is raised above a certain point. Many fatalities and serious injuries occur because a crane was not provided with a limit switch or the limit switch malfunctioned.

If a limit switch isn't provided, or if there is a malfunctioning limit switch, the hoist block could run up into the lifting beam or rope drum, severing the cable and dropping the entire assembly and any load on the hook to the floor.

Hoisting Equipment

Sheaves are grooved pulleys that carry the hoisting ropes on overhead cranes. Sheave grooves are smooth and free from surface defects.

Sheaves in the bottom blocks have close-fitting guards that prevent ropes from becoming fouled when the block is lying on the ground with rope loose. The hazard, if the guards are not installed, is that hoisting rope can come off the sheave groove and become entangled on the shaft, creating binding or shaving of the hoisting rope.

One of the common conditions associated with cranes is the hoisting rope itself. It is required that the hoisting ropes have at least two wraps remaining on the hoist drum when the hook is in its extreme low position.

Inspection

All functional operating mechanisms, air and hydraulic systems, chains, rope slings, hooks, and other lifting equipment must be visually inspected daily.

Chains, cables, ropes, and hooks on overhead and gantry cranes must be visually inspected daily for deformation, cracks, excessive wear, twists, stretch and defective gear must be replaced or repaired.

Complete inspection of the crane must be performed at 1 month to 12-month intervals. The inspection includes Deformed, cracked, corroded, worn, or loose members or parts; the brake system; limit indicators (wind, load); power plant and electrical apparatus.

Handling the Load

One of the most significant hazards with cranes is overloading. A crane must not be loaded beyond its rated load capacity for any reason. "Rated load" means the maximum load that a crane or individual hoist is designed and built by the manufacturer as shown on the equipment name plate.

A load means the total weight on the load block or hook and includes any lifting devices such as magnets, spreader bars, chains and slings.

Every load lifted by a crane must be well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches.

To prevent swinging of a load, the hook is brought directly over the load when the attachment is made. You aren't permitted on the load or hook or lifting device while hoisting, lowering, or traveling.

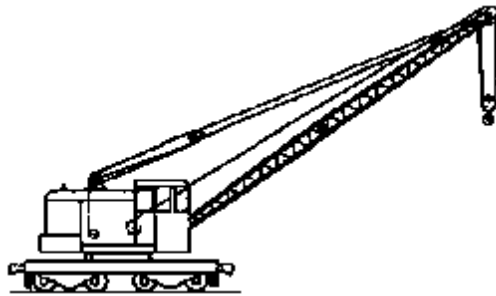
The operator of a crane must avoid carrying loads over other people. This hazard is significant when using a magnet or a vacuum device to lift scrap material.

Operators of cranes aren't permitted to leave their position at the controls while the load is suspended. This includes suspended lifting devices such as magnets or vacuum lifts.

At the beginning of each operator's shift, the upper limit switch of each hoist must be tried out under no-load conditions. The hoist limit switch that controls the upper limit of travel of the load block must never be used as an operating control.

Crawler Locomotive and Truck Cranes

This section applies to crawler cranes, locomotive cranes, wheel-mounted cranes, both truck and self-propelled wheel, that have the same characteristics. It includes cranes that are powered by internal combustion engines or electric motors and utilize drums and ropes. Cranes designed for railway and automobile wreck clearances are expected. The requirements of this section are applicable only to machines when used as lifting cranes.



Only employees selected or assigned by the employer, as being qualified must be permitted to operate a crane.

Inspection

All functional operating mechanisms, control systems, safety devices, air and hydraulic systems, chains, rope slings, hooks, and other lifting equipment are visually inspected daily.

Chains, ropes and hooks are visually inspected daily for deformation, cracks, excessive wear, twists; stretch and defective gear must be replaced or repaired.

Complete inspection of the crane must be performed at 1 month to 12-month intervals. The inspection must include: Deformed, cracked, corroded, worn, or loose members or parts; the brake system; limit indicators (wind, load); power plant; electrical apparatus; and travel steering, braking and locking devices.

Handling the Load

Size of the Load

One of the most significant hazards with cranes is overloading. A crane must not be loaded beyond its rated load capacity for any reason. "Rated load" means the maximum load that a crane or individual hoist is designed and built by the manufacturer as shown on the equipment name plate.

A load means the total weight on the load block or hook and must include any lifting devices such as magnets, spreader bars, chains and slings.

Attaching the Load

The hoist rope must not be wrapped around the load. The load must be attached to the hook with slings or other approved devices.

Moving the Load

Requirements for moving loads include:

- The crane is level and blocked properly.
- The load is secured and balanced in the sling or lifting device before it is lifted more than a few inches.
- Hoist rope can't have a kink
- Multiple part lines can't be twisted around each other.
- The hook should be brought over the load to prevent swinging.
- During hoisting, care must be taken that there is no sudden acceleration or deceleration of the moving load and that the load doesn't contact any obstructions.
- Side loading of booms must be limited to freely suspended loads. Cranes must not be used for dragging loads sideways.
- The operator must test the brakes each time a load approaching the rated load is handled by raising it a few inches and applying the brakes.
- Outriggers must be used when the load exceeds the rated load without outriggers.
- Neither the load nor the boom must be lowered below the point where less than two full wraps of rope remain on their drums.
- Before traveling a crane with a load, a designated person must be responsible for determining and controlling safety.

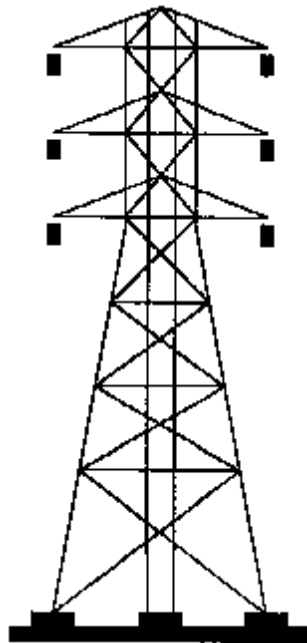
- When rotating the crane, sudden starts and stops must be avoided.
- When a crane is to be operated at a fixed radius, the boom-hoist pawl or other positive locking devices must be engaged.

Holding the Load

Operators must not be permitted to leave their position at the controls while the load is suspended.

No person must be permitted to pass under a load on the hook.

Operating Near Electric Power Lines



Clearances

Except where the electrical distribution and transmission lines have been de-energized and grounded or when insulating barriers have been erected to prevent physical contact with the lines, the clearance between the lines and any part of the crane or load must be:

- 10 feet for lines rated 50 kV or below.
- For lines rated over 50 kV, never less than 10 feet.
- In transit with no load and boom lowered the clearance must be a minimum of 4 feet.

Overhead Wire

Any overhead wire must be considered an energized line until the electrical utility authorities indicate that it isn't an energized line.

Derricks

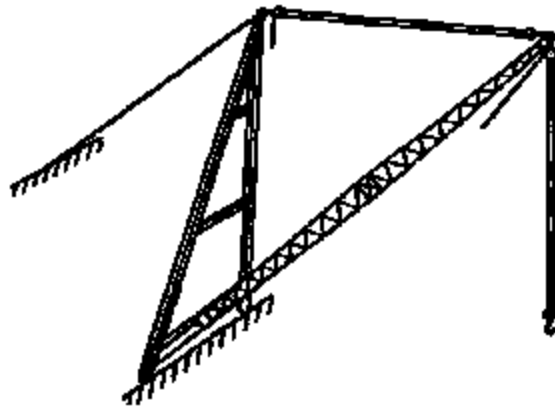
A "derrick" is an apparatus consisting of a mast held at the head by guys or braces, with or without a boom, for use with a hoisting mechanism and operating ropes.

General Requirements

This section applies to guy, basket, breast, gin pole, Chicago boom, and A-frame derricks, capable of handling loads at variable reaches and powered by hoists through systems of rope, used to perform lifting hook work, single or multiple line bucket work, grab, grapple, and magnet work.

Load Ratings

For permanently installed derricks with fixed lengths of boom, guy, and mast, a durable and clearly legible rating chart is attached where it is visible to the operator. The chart includes:



- Manufacturer's approval load ratings at corresponding ranges of boom angle or operating radii.
- Specific lengths of components on which the load ratings are based.
- Required parts for the hoist.

For non-permanent installations, the manufacturer provides information so that capacity charts can be prepared for the particular installation. The capacity charts must be located at the derricks or the job site office.

Inspection

All functional operating systems, control systems, safety devices, chords and lacing, tension in guys, plumb of the mast, air and hydraulic systems, rope, hooks, and electrical apparatus must be visually inspected daily.

Complete inspection of the derrick must be performed at 1 month to 12-month intervals. The inspection must include deformed, cracked, corroded, worn, or loose members or parts; power plant; and foundation or supports.

Handling the Load

Size of the Load

No derrick must be loaded beyond its rated load.

Attaching the Load

The hoist rope must not be wrapped around the load. The load must be attached to the hook with slings.

Moving the Load

Some of the requirements for moving loads include:

- The load should be secured and balanced in the sling or lifting device before it is lifted more than a few inches.
- Before starting to hoist, the following conditions must be noted:
 - Hoist rope can't have a kink
 - Multiple part lines must not be twisted around each other.
 - The hook should be brought over the load in such a manner as to prevent swinging.
- During hoisting, care must be taken that:
 - There is no sudden acceleration or deceleration of the moving load.
 - Load does not contact any obstructions.
- The operator must test the brakes each time a load approaching the rated load is handled by raising it a few inches and applying the brakes.
- Neither the load nor the boom must be lowered below the point where less than two full wraps of rope remain on their respective drums.

Holding the Load

The operator must not be allowed to leave their position at the controls while the load is suspended.

If the load must remain suspended for considerable time, a dog, or pawl and ratchet, rather than the brake alone, must be used to hold the load.

Securing Boom

Dogs, pawls, or other positive holding mechanisms on the hoist must be engaged. When not in use, the derrick boom must be:

- Laid down
- Secured to a stationary member, as nearly under the head as possible, by attachment of a sling to the load block; or
- Hoisted to a vertical position and secured to the mast.

Other Requirements

Guards

Exposed moving parts, such as gears, ropes, set screws, chains, chain sprockets, and reciprocating components, that are a hazard under normal operating conditions must be guarded.

Operating Near Electrical Power Lines

Except where the electrical distribution and transmission lines have been de-energized and grounded or when insulating barriers have been erected to prevent physical contact with the lines, the minimum clearance between the lines and any part of the derrick or load must be:

- 10 feet for lines rated 50 kV.
- For lines rated over 50 kV, never less than 10 feet.

Overhead Wire

Any overhead wire must be considered an energized line until the electrical utility authorities indicate that it is not an energized line.

Helicopters

This section deals with helicopter crane operations. Some of the basic requirements are discussed below.

Helicopter cranes must comply with any applicable regulations of the Federal Aviation Administration.

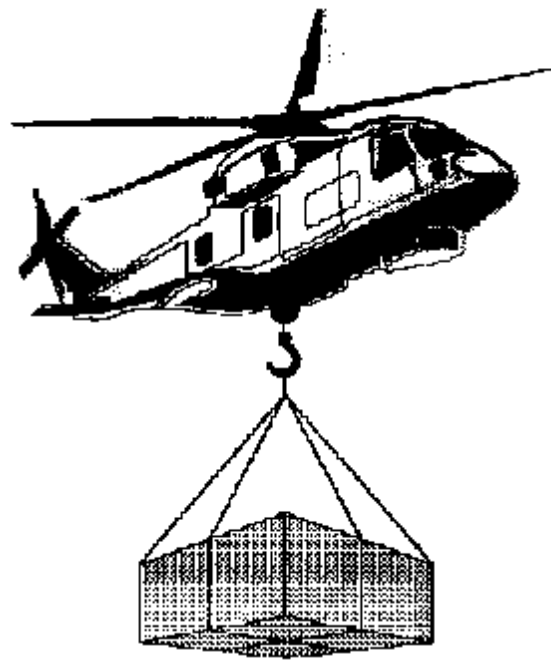
Prior to each day's operation, a briefing must be conducted that sets the plan of operation for the pilot and ground personnel.

Slings and Tag Lines

Loads must be properly slung. Tag lines must be of a length that will not permit their being drawn up into the rotors.

Cargo Hooks

All electrically operated cargo hooks must have the electrical



activating device installed to prevent inadvertent operation. These cargo hooks must be equipped with an emergency mechanical control for releasing the load.

The cargo hooks must be tested prior to each day's operation to determine that the release functions properly, both electrically and mechanically.

Personal Protective Equipment

Personal protective equipment (complete eye protection and hard hats with chinstraps) must be provided by the employer and used by employees receiving the load.

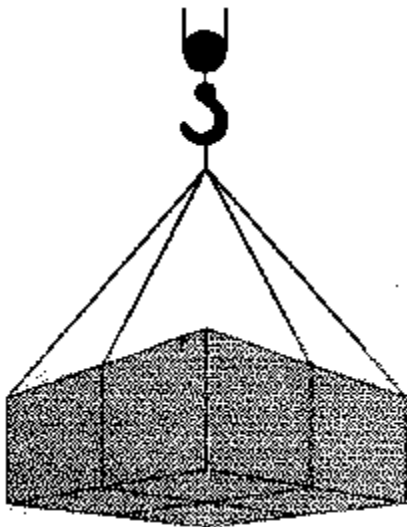
Loose fitting clothing likely to flap, and be snagged on the hoist lines, can't be worn.

Loose Gear Housekeeping

All loose gear within 100 feet of the place of lifting the load or depositing the load must be secured or removed.

Good housekeeping must be maintained in helicopter loading and unloading areas.

Hooking and Unhooking Loads



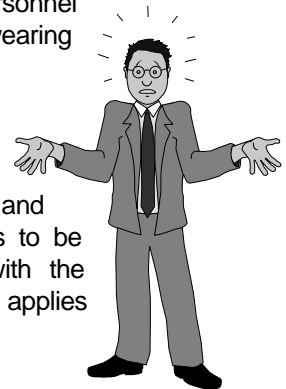
Employees are not permitted to perform work under hovering craft except when necessary to hook or unhook loads.

Static Charge

Static charge on the suspended load must be dissipated with a grounding device before ground personnel touch the suspended load, unless all ground personnel who can touch the suspended load are wearing protective rubber gloves.

Signal Systems

The employer must instruct the air crew and ground personnel on the signal systems to be used and must review the systems with the employees before hoisting the load. This applies to both radio and hand signal systems.



Approach Distance

No employees must be permitted to approach within 50 feet of the helicopter when the rotor blades are turning, unless their work duties require their presence in that area.

Communications

There must be constant reliable communication between the pilot and a designated employee of the ground crew during the period of loading and unloading. The signalman must be clearly distinguishable from other ground personnel.

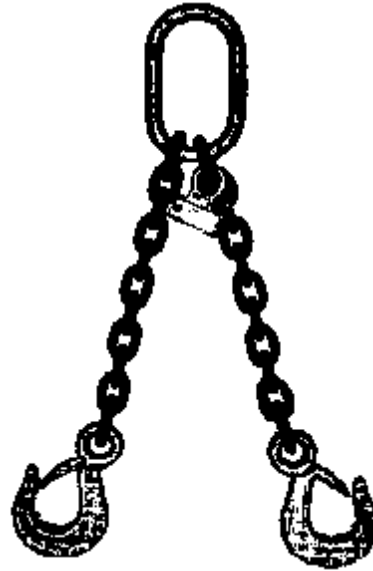
Slings

This section applies to slings used in conjunction with other material handling equipment for the movement of material by hoisting. The types of slings covered are made from alloy steel chain, wire rope, metal mesh, natural or synthetic fiber rope (conventional three strand construction), and synthetic web (nylon, polyester, and polypropylene).

Safe Operating Practices

Whenever any sling is used, the following practices must be observed:

- Slings that are damaged or defective must not be used.
- Slings can't be shortened with knots, bolts, or other makeshift devices.
- Sling legs can't have kinks.
- Slings must not be loaded in excess of their rated capacities.
- Slings used in a basket hitch must have the loads balanced to prevent slippage.
- Slings must be securely attached to their loads.
- Slings must be padded or protected from the sharp edges of their loads.
- Suspended loads must be kept clear of all obstructions.
- All employees must be kept clear of loads about to be lifted and of suspended loads.
- Hands or fingers must not be put between the sling and its load while the sling is being tightened around the load.
- Shock loading is prohibited.
- A sling must not be pulled from under a load when the load is resting on the sling.



Inspections

Each day before being used, the sling and all fastenings and attachments must be inspected for damage or defects.

Damaged or defective slings must be immediately removed from service.

Alloy Steel Chain Slings



Sling Identification

Alloy steel chain slings must have permanently attached identification stating size, grade, rated capacity, and reach.

Sling Use

Alloy steel chain slings must not be used with loads in excess of the rated capacities.

Safe Operating Temperatures

Alloy steel chain slings must be permanently removed from the service if they are heated above 1000°F. When exposed to service temperatures in excess of 600°F, maximum working load limits must be reduced.

Repairing Slings

Worn or damaged alloy steel chain slings or attachments must not be used until repaired.

Deformed Attachments

Alloy steel chain slings with cracked or deformed master links, coupling links or other components must be removed from service.

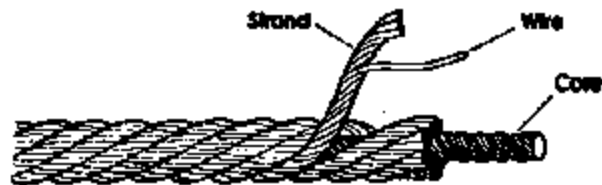
Wire Rope Slings

Sling Use

Wire rope slings must not be used with loads in excess of the rated capacities.

Safe Operating Temperatures

Fiber core wire rope slings must be removed from service, if they are exposed to temperatures in excess of 200°F. The non-fiber core wire rope slings are used at temperatures above 400°F, or below minus 60°F, based on the recommendations of the sling manufacturer.



Removal from Service

Wire rope slings must be immediately removed from service if any of the following conditions are present:

- Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay.
- Wear or scraping of one-third the original diameter of outside individual wires.
- Kinks, crushing, birdcages or any other damage.
- Evidence of heat damage.
- End attachments that are cracked, deformed or worn.
- Hooks that have been opened more than 15 percent of the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook.
- Corrosion of the rope or end attachments.

Metal Mesh Slings

Sling Marking

Each metal mesh sling must have a durable marking that state the rated capacity for vertical basket hitch and choker hitch loads.

Handles

Handles must have a rated capacity at least equal to the metal fabric and exhibit no deformation after proof testing.

Attachments of Handles to Fabric

The fabric and handles must be joined so that:

- The rated capacity of the slings is not reduced.
- The load is evenly distributed across the width of the fabric.
- Sharp edges will not damage the fabric.

Sling Coatings

Coatings that diminish the rated capacity of a sling must not be applied.

Sling Use

Metal mesh slings must not be used to lift loads in excess of their rated capacities.

Safe Operating Temperatures

Metal mesh slings that are not impregnated with elastomers can be used in a temperature range from minus 20°F to plus 550°F without decreasing the working load limit. Metal mesh slings impregnated with polyvinyl chloride or neoprene can be used only in a temperature range from zero degrees to plus 200°F.

Repairs

Metal mesh slings that are repaired must not be used unless repaired by a metal mesh sling manufacturer or an equivalent entity.

Removal from Service

Metal mesh slings must be immediately removed from the service if any of the following conditions are present:

- A broken weld or brazed joint along the sling edge
- Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion
- Lack of flexibility due to distortion of the fabric
- Distortion of the female handle so that the depth of the slot is increased more than 10 percent
- Distortion of either handle so that the width of the eye is decreased more than 10 percent
- A 15 percent reduction of the original cross sectional area of metal at any point around the handle eye
- Distortion of either handle out of its plane

Natural and Synthetic Fiber Rope Slings

Sling Use

Fiber rope slings made from conventional three-strand construction fiber rope must not be used with loads in excess of the rated capacities.

Safe-Operating Temperatures

Natural and synthetic fiber rope slings, except for wet frozen slings, can be used in a temperature range from minus 20°F plus 180°F without decreasing the working load limit.

Splicing

Spliced fiber rope slings must not be used unless they have been spliced in accordance with recommendations of the manufacturer.

Removal from Service



Natural and synthetic fiber rope slings must be immediately removed from service if any of the following conditions are present:

- Abnormal wear
- Powdered fiber between strands
- Variations in the size or roundness of strands
- Discoloration or rotting
- Distortion of hardware in the sling

Repairs

Only fiber rope slings made from new rope must be used. Use of repaired or reconditioned fiber rope slings is prohibited.

Synthetic Web Slings

Sling Identification

Each sling must be marked or coded to show the rated capacities for each type of hitched and type of synthetic web material.

Sling Use

Synthetic web slings must not be used with loads in excess of the rated capacities.

Environmental Conditions

When synthetic web slings are used, the following precautions must be taken:

- Nylon web slings must not be used where fumes, vapors, sprays, mists or liquids of acids or phenols are present.
- Polyester and polypropylene web slings must not be used where fumes, vapors, sprays, mists or liquids of caustics are present.
- Web slings with aluminum fittings must not be used where fumes, vapors, sprays, mists or liquids of caustics are present.

Safe Operating Temperatures

Synthetic web slings of polyester and nylon must not be used at temperatures in excess of 180°F. Polypropylene web slings must not be used in excess of 200°F.

Repairs

Synthetic web slings that are repaired must not be used unless repaired by a sling manufacturer or any equivalent entity.

Removal from Service

Synthetic web slings must be immediately removed from service if any of the following conditions are present:

- Acid or caustic burns;
- Melting or charring of any part of the sling surface;
- Snags, punctures, tears, or cuts;
- Broken or worn stitches; or
- Distortion of fittings.

Summary

A detailed outline of Lesson 8 summarizes each area that you learned as follows:

A. Handling Materials

1. Using Mechanical Equipment
2. Secure Storage
3. Housekeeping

B. Rim Wheels

1. Types of Wheels/Tires
2. Hazards
3. Employee Training
4. The Servicing Equipment
5. Safe Operating Procedures for Multi-Piece and Single-Piece Rim Wheels

C. Powered Industrial Trucks

1. Designations
2. Safety Guards
3. Changing and Charging Storage Batteries

4. Trucks and Railroad Cars
5. Operating Training
6. Truck Operations
7. Traveling
8. Loading
9. Operation of the Truck
10. Maintenance of Industrial Trucks

D. Overhead and Gantry Cranes

1. Cabs
2. Footwalks and Ladders
3. Stops
4. Bumpers
5. Rail Sweeps and Guards
6. Inspection
7. Handling the Load

E. Crawler Locomotive and Truck Cranes

1. Inspection
2. Handling the Load
3. Operating Near Electric Power Lines

F. Derricks

1. General Requirements
2. Load Ratings
3. Inspection
4. Handling the Load
5. Other Requirements

G. Helicopters

1. Slings and Tag Lines

2. Cargo Hooks
3. Personal Protective Equipment
4. Loose Gear Housekeeping
5. Hooking and Unhooking Loads
6. Static Charge
7. Signal Systems
8. Approach Distance
9. Communications

H. Slings

1. Safe Operating Practices
2. Inspections
3. Alloy Steel Chain Slings
4. Wire Rope Slings
5. Metal Mesh Slings
6. Safe Operating Temperatures
7. Synthetic Web Slings

Lesson 8 Test – Materials Handling

1. **More employees are injured in industry while moving materials than while performing any other single function. Storage areas are kept free from materials that create hazards. Which item is not related to safe materials storage?**
 - a) Tripping.
 - b) Fire.
 - c) Moisture.
 - d) Pests.
2. **A rim wheel is a component assembly. What item below is not one of the components?**
 - a) The assembly used to hold the tire.
 - b) The part of the air chamber.
 - c) The way of attaching the assembly.
 - d) The vehicle axle.
3. **The effect of the sudden release of the pressurized air causes accidents involving single-piece and multi-piece rim wheels. Which statement is false?**
 - a) Single-rim wheel accidents occur when the pressurized air contained in the tire is suddenly released, whether by the bead breaking or the bead slipping over the rim flange.
 - b) The severity of the hazard is related to the size of the rim flange and the relationship to the air volume released during separation.
 - c) The principal hazards involve pressurized air that, once released, can pick up and hurl you across the shop if you are close to the rim wheel and within the trajectory.
 - d) It can propel the rim wheel in any potential path or route that a rim wheel component can travel during an explosive separation.
4. **Workplaces using electrically powered industrial trucks have battery-changing areas for storage batteries. Which statement below is false?**
 - a) Determined by the number of electrically powered industrial trucks, there is a separate changing and charging area required for batteries used in motor vehicles, cars and trucks.
 - b) Facilities are provided for flushing and neutralizing spilled electrolyte, for fire protection, for protecting charging apparatus from damage by trucks, and for adequate ventilation of air contaminants from gassing batteries.
 - c) Smoking is prohibited in each charging area.
 - d) Precautions are taken to prevent open flames, sparks, or electric arcs in battery charging areas.

5. Which of the following requirements regarding industrial truck operations is false?

- a) No person is allowed to stand or pass under the raised portion of any truck.
- b) Unauthorized personnel can't ride on powered industrial trucks.
- c) An attended industrial truck is when the vehicle is idling for more than 15 minutes.
- d) When an industrial truck is left unattended, power is shut off, brakes set and wheels are blocked.

6. For overhead and gantry cranes, which statement below is false?

- a) A cab-operated crane is an overhead or gantry crane controlled by an operator in a cab located on the bridge or trolley.
- b) A footwalk is provided on the drive side along the entire length of the bridge of all cranes having the trolley running on top of the girders.
- c) Every overhead or gantry crane, where the trolley runs on top of the bridge girder, has stops at either end of the limits of the travel of the trolley.
- d) A bumper is a break-away rail for immediately stopping a moving crane or trolley when it reaches the end of its permitted travel.

7. The most significant hazard with cranes is what?

- a) Attaching the load.
- b) Overloading the load.
- c) Moving the load.
- d) Holding the load.

8. A derrick has a mast held with guys or braces, with or without a boom, and used with a hoisting mechanism and operating ropes. Which statement below is not true?

- a) The hoist rope must be wrapped around the load before attaching to the hook with slings.
- b) The load should be secured and balanced in the sling or lifting device before it is lifted more than a few inches.
- c) If the load must remain suspended for considerable time, a dog, or pawl and ratchet must be used to hold the load.
- d) Any overhead wire must be considered an energized line until the electrical utility authorities indicate that it is not an energized line.

9. For helicopters, loads must be properly slung and tag lines must be of a length that will not permit their being drawn up into the rotors. Which statement is false?

- a) All electrically operated cargo hooks must have electrical activating devices and equipped with an emergency mechanical control for releasing the load.
- b) Employees receiving the load must use personal protective equipment that have eye protection, hard hats and chinstraps.
- c) Loose fitting clothing likely to flap, and be snagged on the hoist lines, can't be worn.
- d) Static charge on the suspended load is grounded when you touch the suspended load with protective rubber gloves.

10. Slings are used with material handling equipment for the movement of material by hoisting. Whenever any sling is used, which single practice should be used?

- a) Slings shortened with knots, bolts, or other makeshift devices.
- b) Slings used in a basket hitch with unbalanced loads.
- c) Slings padded or protected from the sharp edges of their loads.
- d) Hands or fingers put between the sling and its load while the sling is being tightened.

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